HAMMOND RIVER HOLDINGS LIMITED

Environmental Impact Assessment (EIA) Registration

Glenvale Gypsum Quarry Project, Glenvale, New Brunswick

December 2022 – 22-4280

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December 21, 2022

New Brunswick Department of Environment and Local Government
Environmental Impact Assessment Branch
P.O. Box 6000
20 McGloin Street, 3rd Floor
Fredericton, NB
E3B 5H1

Attention: Ms. Crystale Harty
Director, Environmental Impact Assessment Branch

RE: Environmental Impact Assessment (EIA) Registration: Proposed Glenvale Gypsum Quarry Project, Glenvale, New Brunswick

On behalf of Hammond River Holdings Limited, Dillon Consulting Limited (Dillon) is pleased to submit this environmental impact assessment (EIA) registration document for the proposed Glenvale Gypsum Quarry Project, for your review and consideration.

Dillon looks forward to your timely review of the documentation. Please contact the undersigned if you have any questions or require additional information.

Sincerely,

DILLON CONSULTING LIMITED

Jonathan Oliver, P.Geo., M.Sc.
Project Manager, Associate

JTO:jmt

Enclosure

Our file: 22-4280

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1.0 Introduction

This document is an environmental impact assessment (EIA) registration for the proposed Glenvale Gypsum Quarry Project (the Project) proposed by Hammond River Holdings Limited (Hammond River Holdings) in the community of Glenvale, Westmorland County, New Brunswick. The Project consists of the development of a new open pit quarry for the extraction of gypsum to be used in the production of gypsum wallboard at manufacturing facilities in New Brunswick. The Project location is shown in **Figure 1.1.1**.

The Project is an "undertaking" under items (a) and (v) of Schedule A of the New Brunswick Environmental Impact Assessment Regulation – Clean Environment Act (EIA Regulation) ["*(a) all commercial extraction or processing of a mineral as defined in the Mining Act*" and "*(v) all enterprises, activities, projects, structures, works or programs affecting two hectares or more of bog, marsh, swamp, or other wetland.*"]. As such, the Project must be registered under Section 5(1) of the EIA Regulation, and at minimum a determination review will be conducted.

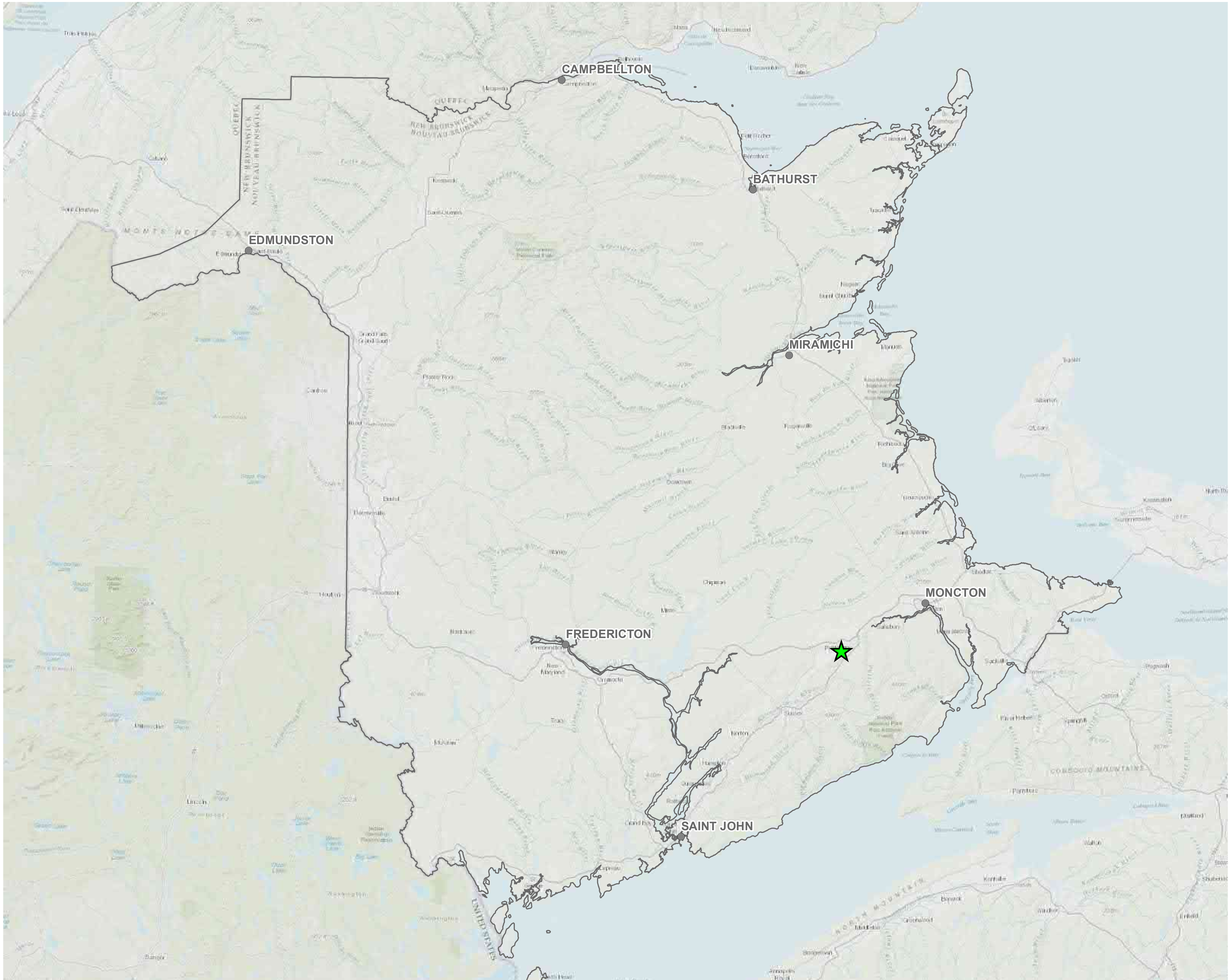
This EIA Registration document is submitted to the New Brunswick Department of Environment and Local Government (NBDELG) under Section 5(2) of the New Brunswick *Environmental Impact Assessment Regulation* 87-83 of the *Clean Environment Act*. It has been prepared by Dillon Consulting Limited (Dillon) on behalf of Hammond River Holdings to provide information to the NBDELG and its associated Technical Review Committee (TRC) to assist in the EIA review of the Project.

1.1 Proponent Information

The Project may be identified as the "Glenvale Gypsum Quarry Project". The proponent of the Project is Hammond River Holdings Limited. The Proponent's contact information is provided in **Table 1.1.1** below.

Table 1.1.1: Proponent Information

Name of Project:	Glenvale Gypsum Quarry Project
Name of Proponent:	Hammond River Holdings Limited
Mailing Address of Proponent:	300 Union Street, Saint John, NB E2L 4Z2
Proponent's Contact Person for the purposes of this EIA Registration:	Daniel Guest Tel: 506.633.3331 Email: info@jdirving.com Website: www.GlenvaleProject.com
Environmental Consultant that led the preparation of this EIA Registration:	Jonathan T. Oliver, P.Geo., M.Sc. Project Manager, Associate Dillon Consulting Limited 1149 Smythe Street, Suite 200 Fredericton, NB E3B 3H4 Tel.: 506.444.9717 ext. 5108 Email: joliver@dillon.ca



HAMMOND RIVER HOLDINGS LIMITED
PROPOSED GLENVALE GYPSUM QUARRY

PROJECT LOCATION
FIGURE 1.1.1

Major Cities and towns
Site Location
Provincial Boundary

0 12.5 25 50 km
SCALE 1:1,500,000

MAP DRAWING INFORMATION:
DATA PROVIDED BY DILLON CONSULTING LIMITED,
SERVICE LAYER CREDITS: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), SWISS TOPO, OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

MAP CREATED BY: RP
MAP CHECKED BY: JO
MAP PROJECTION: NAD_1983_CSRS_New_Brunswick_Stereographic

DILLON CONSULTING

PROJECT: 22-4280
STATUS: FINAL
DATE: 2022-08-05

FILE LOCATION: K:\2022\224280\Product\Client\Glenvale\Figure 1.1.1 Project Location.mxd

1.2 The Undertaking

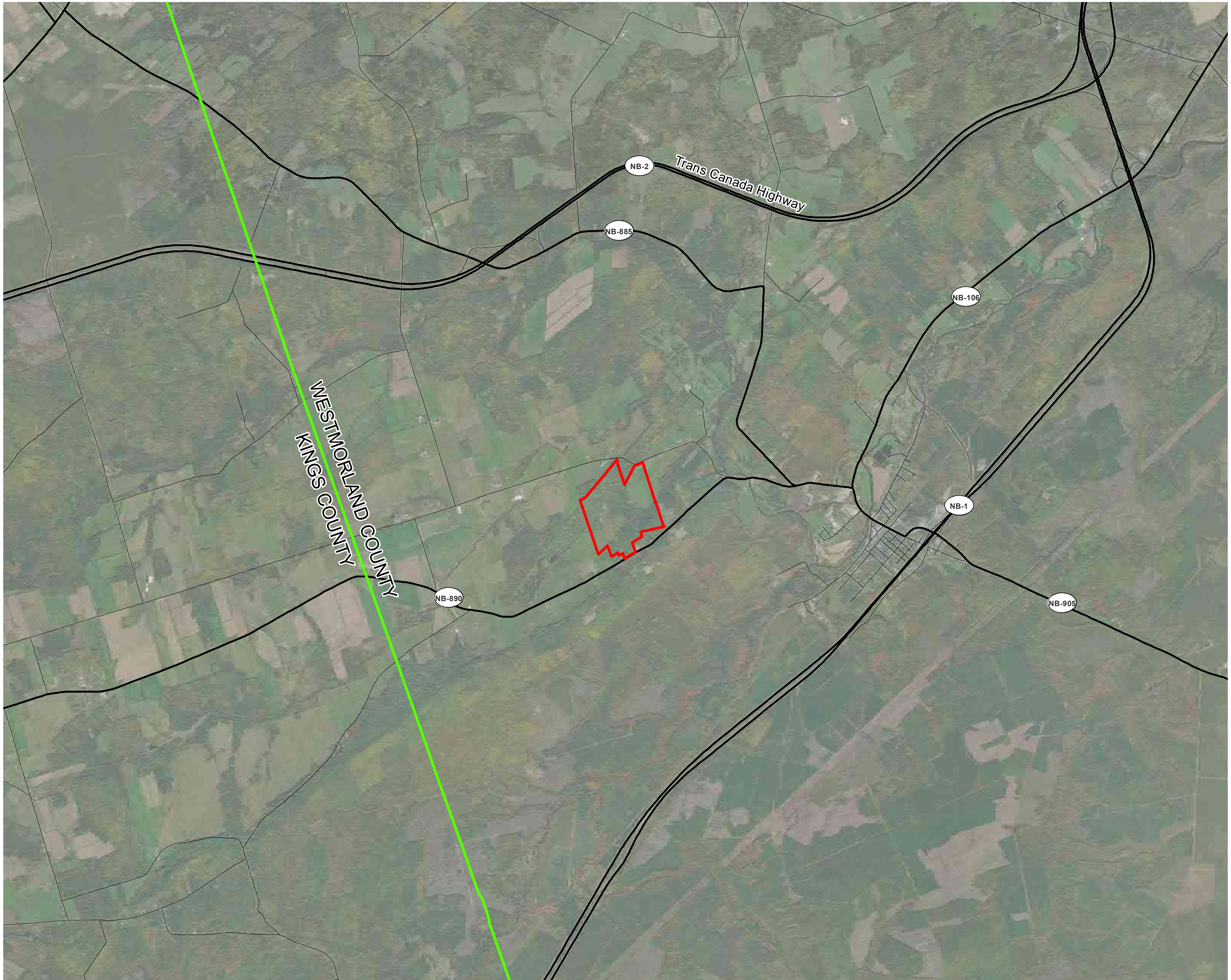
A high-level description of the undertaking is provided in this section.

1.2.1 Project Overview (Nature of the Undertaking)

Hammond River Holdings has been conducting exploration programs in Southern New Brunswick for the potential quarrying of gypsum for use by customers as a raw material in the production of gypsum wallboard. The primary customer identified by Hammond River Holdings is the Irving Wallboard facility located in Saint John, New Brunswick. In 2018, a gypsum resource was identified in Upham, New Brunswick. Following extensive EIA and permitting, extraction from the Upham East Gypsum Quarry began in July 2020 and was anticipated to last 10 years. In preparation for the eventual exhaustion of gypsum at the Upham East quarry, exploration has continued for additional gypsum resources. The continued exploration has identified a reserve of approximately 3.0 million metric tonnes of suitable quality gypsum rock located near ground surface in the Glenvale property (**Figure 1.2.1**) that could reasonably be extracted in an open pit configuration for subsequent processing and sale to customers.

Although Project planning and development is at an early stage, it can be expected that the Project would consist of many of the following components, subject to further design and confirmation by Hammond River Holdings:

- an open pit (quarry), for extracting up to 300,000 metric tonnes per year (t/yr) of gypsum rock;
- use of explosives, for blasting the open pit to extract gypsum rock;
- portable crushing equipment, for primary crushing of extracted gypsum rock to a diameter of approximately 15-20 cm (6-8 inches);
- heavy mobile equipment (e.g., front end loader, excavators, bulldozer, dump trucks) for moving gypsum rock, topsoil, and overburden on-site and for loading gypsum into trucks for transportation to customers;
- a storage area, for temporary storage of crushed gypsum while awaiting transportation;
- conveying and/or stacking equipment at the storage area, to stockpile crushed gypsum, as required;
- storage areas for overburden and topsoil, for use in later site reclamation;
- facilities for pit dewatering and runoff management, consisting of a sump at the bottom of the open pit, a water management pond (settling pond), and associated perimeter and drainage channels, for collecting and storing contact water from the site to allow for settling of suspended sediments prior to release to the natural environment;
- a truck scale, for weighing trucks entering and leaving the property;
- a security gate, for controlling access to the site;
- a portable trailer, to serve as a site office/lunch room; and,
- an access road from the provincial Route 890 to the site, and internal roads between various components of the Project.



HAMMOND RIVER HOLDINGS LIMITED
PROPOSED GLENVALE GYPSUM QUARRY

SITE LOCATION PLAN
FIGURE 1.2.1

Highway
Road
Counties
Project Development Area

0 0.25 0.5 1 Kilometers

SCALE 1:50,000

MAP DRAWING INFORMATION:
DATA PROVIDED BY DILLON CONSULTING LIMITED, CANVEC
SERVICE LAYER CREDITS: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), SWISS TOPO, OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

MAP CREATED BY: RP
MAP CHECKED BY: JO
MAP PROJECTION: NAD_1983_CSRS_NEW_BRUNSWICK_STEREOGRAPHIC

DILLON CONSULTING

PROJECT: 22-4280
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FILE LOCATION: K:\2022\224280\Product\Client\Glenvale\Figure 1.2.1 Site Location Plan.mxd

Blasting will be conducted by a licensed explosives contractor who will bring the required quantity of explosives to the site on the day that blasting is planned to take place. No explosives storage is expected on-site beyond this daily use.

Construction has been assumed to take approximately 4 months beginning in the fall of 2023 (subject to all approvals being in place by that time). The quarry life is estimated 10 years of production, subject to further confirmation of the resource.

Once overburden materials are removed and stockpiled, gypsum rock will be excavated and/or blasted in the open pit, 6-inch minus (15 cm) using portable crushing equipment on-site, temporarily stored on-site in a designated storage area pending transportation, and eventually transported to customers.

Hammond River Holdings will continue to explore gypsum supply options (either domestic or otherwise) that may supplement the current gypsum supply option. The scope of this EIA Registration document is limited to the Project as currently proposed at the Glenvale property; other potential future gypsum deposits that may become commercially viable over time would be subjected to a separate EIA registration, at the appropriate time.

1.2.2 Purpose/Rationale/Need for the Project

The Project is intended to supply natural gypsum rock for the production of gypsum wallboard to the Irving Wallboard manufacturing facility in Saint John, NB. Currently, the only operating natural gypsum quarrying in New Brunswick is the Upham East Gypsum Quarry. This quarry is in its third year of operation of an expected 10-year lifespan. Thus, another source of gypsum is required for when the Upham East resource is depleted. The Glenvale gypsum deposit has been identified as this potential source.

Demand for wallboard has increased over the past several years. As Upham East is the only producing gypsum quarry in New Brunswick, securing a long-term supply of this important raw material is imperative to the long-term success of the local wallboard production industry.

1.2.2.1 Alternatives to the Project

The Project is intended to provide a technically, economically, and environmentally feasible source of gypsum for producing gypsum wallboard at New Brunswick-based manufacturing facilities. Though there are alternatives to the Project which could include securing other, more distant, sources of synthetic gypsum elsewhere in New Brunswick, mining gypsum elsewhere in New Brunswick, or importing natural gypsum from other jurisdictions, those alternatives were reviewed and would result in greater technical challenges (i.e., gypsum resource not present near surface) and a larger carbon footprint, primarily due to transportation. Synthetic gypsum supplies have proven to be limited in quantity and quality. Recycling of used wallboard is not practical as typical demolition projects do not normally segregate demolition wastes to the extent that wallboard (or the gypsum contained in it) can be efficiently recovered. As such, there are no known alternatives to the Project that would meet the Project purpose.

1.3 Regulatory Context

The anticipated regulatory framework that is expected to apply to the Project, based on Dillon's current understanding of the Project, is discussed below.

1.3.1 Provincial Legislation

The Project is subject to the New Brunswick *Environmental Impact Assessment Regulation* under the *Clean Environment Act*. In addition, several other authorizations, approvals, permits, licenses, and leases from provincial government agencies are required for the Project to proceed. Further information on the applicable provincial regulatory framework for the Project is provided below.

1.3.1.1 *Environmental Impact Assessment Regulation*

The New Brunswick *Environmental Impact Assessment Regulation* 87-83 under the *Clean Environment Act* (EIA Regulation) establishes the EIA process in New Brunswick. The EIA Regulation requires that all "undertakings" listed on Schedule A of the EIA Regulation (including their proposed construction, operation, modification, extension, abandonment, demolition, or rehabilitation) require registration.

Schedule A of the EIA Regulation establishes 24 categories of developments that are considered undertakings. The Project is an undertaking according to items (a) and (v) of Schedule A of the EIA Regulation, as follows:

> *"(a) all commercial extraction or processing of a mineral as defined in the Mining Act."*
>
> *"(v) all enterprises, activities, projects, structures, works or programs affecting two hectares or more of bog, marsh, swamp, or other wetland."*

Although quarries are not typically subject to the EIA Regulation, because the gypsum is being calcined (i.e., heated for water removal) for the purpose of wallboard production (i.e., used for its mineral properties), the Project will need to be registered under Section 5(1) of the EIA Regulation, and an EIA review will be conducted by selected provincial and federal government agencies (referred to as the Technical Review Committee, or TRC) under the direction of the NBDELG.

The requirements for EIA review of a registration document are described in the EIA Guide titled *A Guide to Environmental Impact Assessment in New Brunswick* (NBDELG 2018a). Following submission of a complete EIA Registration document, the TRC will review the submitted information and may require additional information or response to questions arising from their review. At the conclusion of the determination review, the TRC will make a recommendation to the New Brunswick Minister of Environment and Climate Change (the Minister) as to whether a proposed undertaking can proceed, with or without conditions, or whether it requires a more formal EIA (referred to as a "comprehensive review"). The Minister's decision is at his sole discretion in view of the environmental features of the area, the nature and extent of the anticipated environmental effects of the Project, proposed mitigation, and/or other factors.

1.3.1.2 Other Potential Provincial Authorizations, Approvals, Permits, Licenses, or Leases

In addition to the provincial EIA review of the Project, other provincial authorizations, approvals, permits, licenses, or leases may be required for the Project, including but not limited to those in **Table 1.3.1** below.

Table 1.3.1: Other Potential Provincial Authorizations, Approvals, Permits, Licenses, or Leases

Name of Authorization, Approval, Permit, License, or Lease	Purpose	Enabling Legislation/Regulation	Issuing Provincial Agency
Archaeological Field Research Permit (AFRP)	For conducting an archaeological impact assessment (AIA) of the Project site (walkover, shovel testing, monitoring) (likely required)	New Brunswick *Heritage Conservation Act*	New Brunswick Department of Tourism, Heritage and Culture (NBTHC)
Watercourse and Wetland Alteration (WAWA) Permit	For alterations within a watercourse or wetland, or within 30 m of a watercourse or wetland (likely required)	*Watercourse and Wetland Alteration Regulation* under the New Brunswick *Clean Water Act*	New Brunswick Department of Environment and Local Government (NBDELG)
Mining Lease	For extracting and processing of a mineral resource (likely required)	New Brunswick *Mining Act*	New Brunswick Department of Natural Resources and Energy Development (NBDNRED)
Approval to Construct	For construction activities that release contaminants to the environment (likely required)	*Air Quality Regulation* under the New Brunswick *Clean Air Act* and/or *Water Quality Regulation* under the New Brunswick *Clean Environment Act*	New Brunswick Department of Environment and Local Government (NBDELG)
Approval to Operate	For operation activities that release contaminants to the environment (likely required)	*Air Quality Regulation* under the New Brunswick *Clean Air Act* and/or *Water Quality Regulation* under the New Brunswick *Clean Environment Act*	New Brunswick Department of Environment and Local Government (NBDELG)

In addition to the above, depending on the final Project design and configuration, additional permits, approvals, or authorizations may be required, should Hammond River Holdings decide to proceed with certain optional components of the Project (e.g., petroleum storage license, approval of a water well, approval of a septic system); the need for such additional permits, approvals, or authorizations will be confirmed as part of the permitting phase of the Project (following the EIA review).

1.3.2 Federal Legislation

The Project is not believed to require an impact assessment (IA) under the Impact *Assessment Act* (as discussed below). However, some federal permits, approvals, authorizations, or licenses may be required from one or more federal government agencies. The federal regulatory framework that is believed to apply to the Project is discussed below.

1.3.2.1 *Impact Assessment Act*

The Government of Canada enacted the *Impact Assessment Act* (IAA) in August 2019 to supersede the former *Canadian Environmental Assessment Act, 2012* (CEAA 2012) that was previously in force to govern federal environmental assessments in Canada. The IAA, as administered by the Impact Assessment Agency of Canada (the Agency), defines the federal IA process for projects that encompass "Designated Physical Activities" and projects carried out on federal land. Designated Physical Activities are those listed in the *Physical Activities Regulations* under the IAA, which includes 61 types of activities under 10 project categories. Mining and quarrying activities are addressed as items 18 and 19 of these Regulations, as follows:

"18 The construction, operation, decommissioning and abandonment of one of the following:

(a) a new coal mine with a coal production capacity of 5 000 t/day or more;

(b) a new diamond mine with an ore production capacity of 5 000 t/day or more;

(c) a new metal mine, other than a rare earth element mine, placer mine or uranium mine, with an ore production capacity of 5 000 t/day or more;

(d) a new metal mill, other than a uranium mill, with an ore input capacity of 5 000 t/day or more;

(e) a new rare earth element mine with an ore production capacity of 2 500 t/day or more;

(f) a new stone quarry or sand or gravel pit with a production capacity of 3 500 000 t/year or more.

19 The expansion of an existing mine, mill, quarry or sand or gravel pit in one of the following circumstances:

(a) in the case of an existing coal mine, if the expansion would result in an increase in the area of mining operations of 50% or more and the total coal production capacity would be 5 000 t/day or more after the expansion;

(b) in the case of an existing diamond mine if the expansion would result in an increase in the area of mining operations of 50% or more and the total ore production capacity would be 5 000 t/day or more after the expansion;

(c) in the case of an existing metal mine, other than a rare earth element mine, placer mine or uranium mine, if the expansion would result in an increase in the area of mining operations of 50% or more and the total ore production capacity would be 5 000 t/day or more after the expansion;

(d) in the case of an existing metal mill, other than a uranium mill, if the expansion would result in an increase in the area of mining operations of 50% or more and the total ore input capacity would be 5 000 t/day or more after the expansion;

(e) in the case of an existing rare earth element mine if the expansion would result in an increase in the area of mining operations of 50% or more and the total ore production capacity would be 2 500 t/day or more after the expansion;

(f) in the case of an existing stone quarry or sand or gravel pit if the expansion would result in an increase in the area of mining operations of 50% or more and the total production capacity would be 3 500 000 t/year or more after the expansion."

Since the Project is not a coal mine, a diamond mine, a metal mine or mill, a rare earth element mine, a stone quarry, or a sand or gravel pit as defined above, it is not a designated project under IAA. Further, as no aspect of the Project will be built on federal land, it is not expected that the components of the proposed Project will require an IA under the IAA.

1.3.2.2 Other Potential Federal Authorizations, Approvals, Permits, Licenses, or Leases

There are a few federal authorizations, approvals, permits, licenses, or leases that are believed to be required for the Project. The potential federal authorizations, approvals, permits, licenses, or leases that may be required for the Project are listed in **Table 1.3.2** below.

Table 1.3.2: Other Potential Federal Authorizations, Approvals, Permits, Licenses, or Leases

Name of Authorization, Approval, Permit, License, or Lease	Purpose	Enabling Legislation/Regulation	Issuing Federal Agency
Section 35(2) Authorization for harmful alteration, disruption or destruction (HADD) of fish habitat	For temporary or permanent alterations to fish habitat (likely required)	*Fisheries Act*	Department of Fisheries and Oceans Canada (DFO)
Section 34.4(2)(b) Authorization for the death of fish other than by fishing	For incidental mortality of fish during construction or operation (not likely)	*Fisheries Act*	Department of Fisheries and Oceans Canada (DFO)
Authorization by Environment and Climate Change Canada (ECCC)/Canadian Wildlife Service (CWS).	For Project works that would cause the unavoidable destruction or harm to species at risk and/or their critical habitat.	*Species at Risk Act (SARA)*	Environment and Climate Change Canada (ECCC)/Canadian Wildlife Service (CWS).
Authorization/additional protection measures outlined by ECCC/CWS.	For Project works that would cause the unavoidable destruction or harm to migratory birds and/or their nests, or for work conducted between April 8 and August 28 that may disturb or harass migratory birds.	*Migratory Birds Convention Act (MBCA)*	Environment and Climate Change Canada (ECCC)/Canadian Wildlife Service (CWS).

1.3.3 Other Requirements

The Southeast Regional Service Commission recently implemented the *Westmorland-Albert Rural Plan*; a Rural Plan is a provincial regulation that guides land use development and helps prevent land use conflicts between land owners. The Plan zoned the area of the Project as agriculture. The Project is required to be zoned as *Intensive Resource Development* in order to proceed; therefore, the Project has undertaken a rezoning application in parallel with the EIA review. The rezoning was approved December 9, 2022.

1.4 Purpose and Organization of this Document

The purpose of this EIA Registration document is to provide information to the NBDELG and its TRC as part of its review of the environmental effects of the Project in accordance with the EIA Regulation. The EIA Registration document provides a description of the Project, describes existing environmental conditions, identifies mitigation to be employed to minimize the environmental effects of the Project, and characterizes residual environmental effects of the Project during construction, operation, and ultimate closure following the application of mitigation measures and best management practices.

This EIA Registration document is organized in 13 chapters, as follows:

- Chapter 1 provides an introduction to the Project, including proponent information, a Project overview, the purpose/rationale/need for the Project, and an overview of the applicable regulatory framework;
- Chapter 2 provides a Project description of the proposed elements of the Project as currently conceived, and describes how the Project will be constructed, operated, and ultimately reclaimed and closed at the end of the quarry life. Alternative means of carrying out the Project that are technically and economically feasible are discussed. Emissions and wastes from the Project are also described;
- Chapter 3 provides a summary of the environmental setting of the Project;
- Chapter 4 provides information on the methods that were used to evaluate the potential environmental effects of the Project, and the scope of the EIA;
- Chapter 5 provides the assessment of potential environmental effects of the Project, on various valued components (VCs) of the environment of relevance and importance to this EIA, for each Project phase;
- Chapter 6 provides an assessment of potential effects of the environment on the Project;
- Chapter 7 provides an assessment of accidents, malfunctions, and unplanned events that could arise in respect of the Project;
- Chapter 8 describes planned Indigenous engagement activities in respect of the Project;

- Chapter 9 provides a description of planned public and stakeholder engagement activities in respect of the Project;
- Chapter 10 provides a summary of other information included for the Project;
- Chapter 11 provides a summary of the EIA Registration, and resulting conclusions;
- Chapter 12 provides closing remarks; and,
- Chapter 13 provides the references cited in this EIA Registration document.

Additional supporting information is provided in the appendices to this EIA Registration document.

2.0 Project Description

This section provides a description of the facilities and equipment that will comprise the Project, as currently conceived and based on the available information at the time of writing. The Project, as described in this document, is likely to evolve as Project planning and engineering design is completed. So as to not understate the potential environmental consequences of the Project at this planning stage, the Project Description provided in this section presents an “outer envelope” or conservative estimate of the scope, footprint, and environmental effects of the Project. The Project will ultimately be built and operated within the outer envelope as presented in this EIA Report.

The key aspects of the Project are described below, including:

- the Project components, including the likely infrastructure and associated facilities, and planned mitigation for potential environmental effects;
- the activities that will be carried out during construction, operation, and eventual reclamation and closure of the Project;
- alternative means of carrying out the Project; and,
- Project-related emissions, wastes, and other requirements, and their management.

2.1 Project Location

The Project will be carried out near the community of Glenvale, in Westmorland County, New Brunswick. The parcel identification numbers (PIDs) of the property, as referenced by Service New Brunswick, include 00814160, 70076948, and 70654058. The geographic centre of the property is at UTM coordinates N 7386845.13 and E 2561169.61 (NAD83 New Brunswick Stereographic Double projection). The property (**Figure 1.2.1**) has an area of approximately 85 hectares (ha), and is easily accessible via the existing provincial highway network via Route 1 to the southeast of the Project site or the TransCanada Highway to the north.

The Project development area (PDA) is defined as the area of physical disturbance associated with construction and operation of the Project. Specifically, the PDA consists of an area of approximately 85 ha (i.e., conservatively assumed to be the entirety of PIDs 00814160, 70076948, and 70654058) that includes the open pit and all related surface facilities located on the property. The PDA consists of an irregular shaped property, with approximate maximum dimensions of 950 m in an east-west direction, by 1,200 m in a north-south direction. The PDA is the area represented by the physical Project footprint. The subject and neighbouring properties are shown on **Figure 2.1.1.** There are three residences to the north located approximately 200 to 300 m from the expected quarry boundary. There is one residence to the east, and six residences to the south, that have adjoining PIDs with the PDA; however, the residences are 400 to 700 m away from where the main quarry operations will take place.

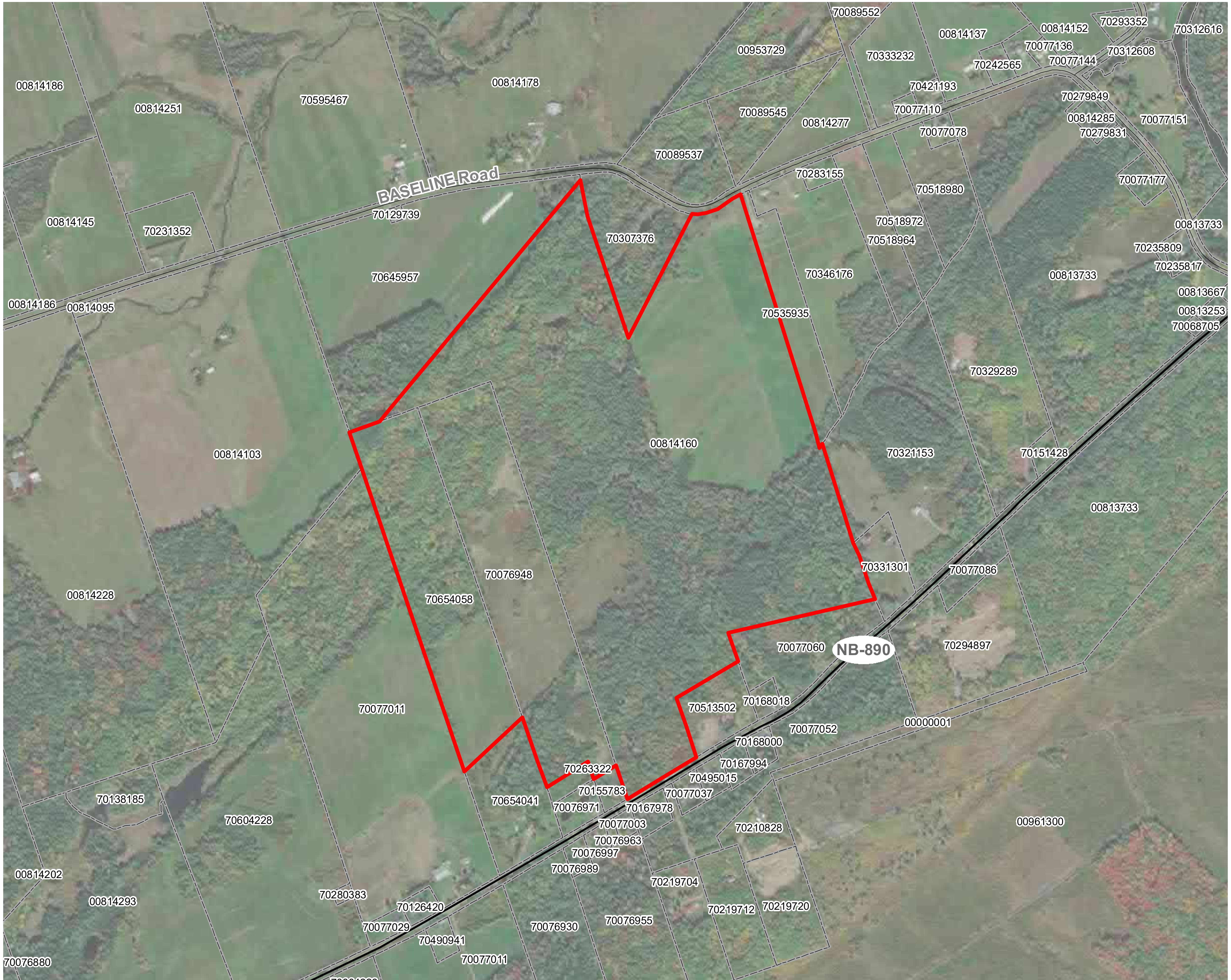
Three small mapped watercourses flow easterly through the site, eventually connecting to the North River. The North River travels north-south, eventually connecting to the Petitcodiac River south of the village of Petitcodiac. The distance between the centre of the PDA to the North River is approximately 1,500 m to the east.

2.1.1 Siting Considerations

The selection of a candidate site for quarrying is dictated by favourable geology that indicates the potential presence of the mineral resource. The selection of the subject property for development as a gypsum quarry has been guided by a mineral exploration program carried out by Dillon on behalf of Hammond River Holdings. In the course of this exploration program, a search of provincial mineral databases was conducted for southern New Brunswick based on surficial and bedrock geology maps of Energy, Mines and Resources Canada as well as the New Brunswick Department of Natural Resources and Energy Development (NBDNRED), combined with other sources of information. This initial screening returned a number of potential candidate sites in southern New Brunswick with potential to contain gypsum resources. From this, the search was narrowed down by considering known information about the mineral resource, environmental considerations, proximity to major roads and infrastructure, proximity to receiving markets, property ownership, and overall potential development. The Glenvale property was identified as a candidate site for further exploration due to a number of these favourable characteristics, in addition to the presence of gypsum outcrops visible on the property surface. Exploration drilling was then conducted in 2019 and 2022 to characterize the mineral resource at the proposed site, and the results of those drilling activities have shown promise in meeting the quality specifications for gypsum used in wallboard manufacturing. As a result, Hammond River Holdings decided to proceed to the EIA and permitting of the site.

2.1.2 Property Ownership

PIDs 00814160, 70076948, and 70654058 comprise the PDA and are owned by Hammond River Holdings Limited.



HAMMOND RIVER HOLDINGS LIMITED
PROPOSED GLENVALE GYPSUM QUARRY

SUBJECT AND SURROUNDING PROPERTIES
FIGURE 2.1.1

Highway
Road
Project Development Area
Property Boundary

0 50 100 200 Meters
SCALE 1:8,000
N
W E
S

MAP DRAWING INFORMATION:
DATA PROVIDED BY DILLON CONSULTING LIMITED, CANVEC
SERVICE LAYER CREDITS: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), SWISS TOPO, OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

MAP CREATED BY: RP
MAP CHECKED BY: JO
MAP PROJECTION: NAD_1983_CSRS_NEW_BRUNSWICK_STEREOGRAPHIC

DILLON CONSULTING

PROJECT: 22-4280
STATUS: FINAL
DATE: 2022-09-21

FILE LOCATION: K:\2022\224280\Product\Client\Glenvale\Figure 2.1.1 Subject and Surrounding Properties.mxd

2.2 Geology of the Glenvale Deposit

The geology of the Glenvale deposit is discussed below.

2.2.1 Regional Geology

The Project area is located within the central part of the Late Devonian to Early Permian Maritimes Basin of southern New Brunswick. More specifically, it occurs along the southeastern margin of the Indian Mountain Deformed Zone, between the Moncton and Cocagne subbasins to the southeast and northwest, respectively (St. Peter and Johnson 2009). These subbasins are two of several, mostly Late Devonian to Early Carboniferous subbasins in the region that are defined by partly structurally controlled depositional centres filled with a variety of mainly terrestrial groups of clastic sedimentary rock units (e.g., the Tournasian-aged Horton and Sussex groups) mostly ultimately derived from surrounding Late Neoproterozoic to Cambrian basement uplifts. Post-depositional and basin-wide inversion tectonism deformed those units and prepared the region for subsequent depositional cycles through the preservation of some parts of existing depositional centres and initiation of new centres coupled with periodic uplift of the basement source terrains. The Indian Mountain Deformed Zone essentially contains exhumed, locally relatively highly deformed and mostly Devonian to older Carboniferous basin rocks, and locally, the crystalline basement to the basin.

A rapid marine incursion blanketed much of lowlands in the region and locally transgressed over higher ground immediately after this event during middle Early Carboniferous time yielding mostly carbonate- and evaporite-bearing units (e.g., the Visean-aged Windsor Group) that rest with marked unconformably on older units and that host the gypsum mineralization in the area. After regression of that sea, another marine incursion transgressed over the southernmost regions of the province. Renewed deposition of mainly terrestrial clastic sedimentary rock sequences (e.g., the Namurian to Westphalian Mabou and Pictou groups) ensued for the rest of Carboniferous to Early Permian time with group boundaries separated by basin-wide disconformable to unconformable contacts, or locally by lateral facies changes (St. Peter and Johnson 2009).

In the Windsor Group of Nova Scotia, five major lithostratigraphic and faunal transgressive-regressive cycles can be present that are related directly to periodic marine incursions. These are referred to Cycles 1 through 5 with decreasing age (Ryan and Giles 2017), but only Cycle 1 and Cycle 2 units are known in New Brunswick. Cycle 1 units are demonstrably present in Windsor Group rocks in the province, but most workers indicate Cycle 2 units present only in the Cumberland and Sackville subbasins (St. Peter and Johnson 2009). Although both cycles host significant gypsum deposits in Nova Scotia, there are important differences in their stratigraphy and constituents relevant for exploration and development of potential gypsum deposits in New Brunswick (Boehner et al. 2003).

2.2.2 Property Geology – Bedrock

Windsor Group rocks on the Hammond River Holdings claim occur in a narrow north-easterly trending belt about eight kilometres long and a few hundred metres wide. Depending on the author, the structure and number of stratigraphic units in and bounding the belt vary in complexity from a fairly straightforward to a much more complex interpretation (St. Peter 2006; Webb 2002a; Webb 2002b). According to the St. Peter (2006), the Windsor Group consist of the Macumber and conformably overlying Upperton formations that unconformably overlie a much older Carboniferous unit to the northwest and is faulted against a slightly younger Carboniferous unit to the southeast. According to Webb (2002a; 2002b), part of the much older unit is considered to be part of the Windsor group with no intervening unconformity; the Windsor Group is interpreted to possibly consist of the Gays River, Parleeville and Clover Hill formations, an unnamed breccia in addition to the Macumber Formation, and the slightly younger Carboniferous unit is not faulted against the Windsor Group rocks to the southeast. Structurally, Webb (2002a; 2002b) indicates several northwesterly-trending faults offsetting the belt as well as faulting and folding within the Windsor Group units. Regardless, both envisage the belt as a whole as having been exhumed from considerable depths along the major north-easterly trending faults along with older units of the Indian Mountain Deformed Zone. Based on work conducted for the current project, the former more simplistic interpretation is applicable overall with some modifications, at least for the central segment of the belt that has been investigated to date. The relevant stratigraphic units in the area and their overall distribution with one additional structural element is as follows.

Gautreau and Weldon formations

Pre-Windsor Group rocks in the Project area occupy the northwestern part of the PDA and comprise the Gautreau and conformably overlying Weldon formations. These units generally dip moderately to steeply towards the southeast but bedding trends indicate local broad-scale folding especially in the vicinity of major faults. At surface in the PDA, the Gautreau Formation consists of grey and minor red, calcareous to non-calcareous mudstone, shale, and fine-to medium-grained sandstone deposited in a fluvial environment, while the Weldon Formation represents distal alluvial deposits of red and lesser grey mudstone, fine- to coarse-grained sandstone with minor conglomerate and limestone (St. Peter 2006). At depth regionally, the Gautreau Formation also hosts a variety of saline-rich, fine-grained clastic sedimentary rocks, salt and glauberite (St. Peter and Johnson 2006).

Macumber and Upperton Formations

Following St. Peter (2006), the Macumber Formation forms the basal part of the Windsor Group in this region and comprises mostly grey to tan and pink wackestone and packstone in a narrow band a few tens of metres wide extending the entire length along the northwestern margin of the belt dipping steeply to the southeast and resting unconformably on the Weldon Formation. The Upperton Formation, comprising mostly of gypsum and anhydrite, forms the remainder of the Windsor Group rocks in the belt along the southeastern flank and is juxtaposed against the Mabou Group rocks by the regional, high-angle reverse and northwesterly dipping Berry Mills Fault. The internal stratigraphy of the formation is not obvious over much of the area investigated here but is assumed to similarly dip nearly vertical to steeply southeast. Vertical banding likely representing original bedding observed in a few drill holes collared for this project within anhydrite and related gypsum intervals along the northwestern part of the property support this assumption. The current study demonstrates that the north-easterly trending shear zone noted previously by Webb (2002a; 2002b) approximately midway through the

Upperton sequence actually affects almost the entire southeastern half of the sulphate unit to within a few tens of metres of the sulphate-Mabou Group contact. The northwestern boundary of the shearing is marked by a zone of tectonic melange. In addition, outcrops of tectonic breccia near the area of drilling demonstrate that the Macumber Formation on the claim is in fault contact with the Upperton Formation, at least in part.

As a result of the differential deformation, the Upperton Formation can be subdivided into two distinct northeasterly trending units: one relatively massive, and the other intensely deformed, to the northwest and southeast, respectively. The more massive unit consists of white to grey, fine-grained and variably nodular gypsum generally underlain at various depths by grey and bluish grey anhydrite with hazy nodular textures. In contrast, the deformed unit comprises mostly white to translucent and grey and brownish grey, medium-grained selenitic platey gypsum defining a pervasive, northeasterly trending and near vertical schistostity. Locally present are boudins or lenses of translucent coarse- to very coarse-grained selenite, irregular pods of unsheared but hackly fractured nodular gypsum and thin selvedges of red or grey mudstone stretched out along the foliation. Anhydrite lenses occur sporadically at variable depths in some of the deformed sequence that are also interpreted as boudins that escaped the intense deformation in part or whole. The deformation of the southwestern part of the property is attributed to movements along the major Berry Mills Fault and to related tectonic melange development (see below).

Mabou Group (undivided) and Salisbury Formation

Post-Windsor Group rocks occupy the southeastern part of the PDA and comprise undivided units of the Mabou Group and unconformably the overlying Salisbury Formation. The Mabou Group rocks consistently dip moderately to steeply towards the southeast, are upright and consist of alluvial red, fine- to coarse-grained sandstone, mudstone, and minor conglomerate. In contrast to the above, the Salisbury Formation blankets most other units unconformably with bedding orientations that are shallowly dipping to horizontal. It consists of a variety of fluvial-type clastic rocks ranging from red to grey and fine- to coarse-grained or pebbly sandstone, mudstone, minor coal, and various types of conglomerate (St. Peter 2006).

Melange

The melange, which is interpreted here as a tectonic type of melange, occurs mostly between the northwestern and southeastern segments of the Upperton Formation and varies in width from a few tens to several tens of metres. Contacts with bounding sulphates are invariably sheared and can be quite diffuse at the metre-scale to abrupt over decimetre-scale core intervals. Like the sulphates, the unit dips steeply with a northeast trend, but does not appear to be totally planar either vertically or horizontally. Drilling indicates that contacts pinch and swell in both directions, and that outliers of apparent melange-like material common in some holes in the deformed sulphates may indicate an anatomizing aspect to the unit as well.

The unit is dominated by red to brownish red and locally grey, semi-consolidated to soft sandy mudstone- mudstone- and siltstone-type and calcareous to non-calcareous material that frequently contains a wide variety of angular to subangular fragments ranging mostly from millimetre to decimetre scales. Longer metre-scale core intersections may indicate even larger fragments are present in this highly mixed unit. Variably textured gypsum clasts and clastic sedimentary rocks are the main contribution to debris in the melange, and gypsum veining/stockworks occur in abundance in parts of some holes. Structurally, the bulk of the unit is irregularly brecciated internally (differentially milled) with no fabric developed to sporadically highly sheared and contorted.

Dark grey and commonly saline shale and siltstone or their apparent highly deformed/altered equivalents, both accompanied by salt or slightly saline veins locally, are assigned here to the Gautreau Formation rocks within the melange. It is notable that salt veining appears to emanate from the melange into bordering anhydritic sulphates over several metres along the northwestern contact of the melange locally. The presence of the Gautreau Formation is interpreted to represent incorporation of units from depth into the melange as an integral part of the Windsor Group's exhumation process ultimately related to high angle reverse faulting/thrusting adjacent to the Berry Mills Fault.

2.2.3 Property Geology – Surficial

Regionally, surficial materials in the planned development area consists of the Horton/Cumberland Till, a brownish-red till consisting of >80% sedimentary clasts originating from the Horton and Cumberland groups (Pronk et al. 2005). On the Glenvale property, overburden thickness ranged from 0 to 11 m in the 48 boreholes drilled. Shallower to virtually no overburden is present over much of the deformed sulphates to the southeast of the melange unit, while generally thicker cover mostly comprising unconsolidated but compact red mud, sandy mud, and silt to the northwest over the massive sulphates. Karsting is extremely well developed over the southeastern unit and apparently much less so the northwest.

2.2.4 Mineralization

In general, the nature of gypsum mineralization varies considerably in the more massive northwestern sulphates versus those in the sheared unit to the southeast. In the northwestern gypsum unit, drill core from 22 boreholes intersected intervals ranging from 0 to 12 m of high-grade gypsum. In the southeastern gypsum unit, drill core from 24 boreholes intersected intervals ranging from a few metres to 40 m of high-grade gypsum. The melange is considered to contain low gypsum grades or to be barren as demonstrated in the holes collared in or intersecting this unit.

Predominantly irregular top-down hydration appears responsible for the fine-grained relatively pervasive mineralization in the northwestern unit creating an undulating veneer of well indurated gypsum after anhydrite within the top several metres to negligible thicknesses of the sulphates. This contrasts markedly with much more complicated processes in the southeastern unit. There, coarser grained recrystallized-type platey gypsum developed a well-defined fabric producing a much softer rock with poor competency overall. This is the most common gypsum type in the southeastern unit that normally prevails to at least several tens of metres depth. Also, unlike the northwestern unit, a variety of secondary incipient to more pervasive and massive types of coarse- to fine-grained gypsum occurs superimposed on the sheared-type gypsum in places. The highly permeable nature of the southeastern unit coupled with its position wedged between the tectonic melange and the Berry Mills Fault undoubtedly allowed for repeated infiltration of hydration fronts from all directions during and since exhumation.

2.3 Description of Project Components

The Project will include an open pit quarry and associated materials handling, primary crushing, storage, water management, and related facilities. In the sections below, each of the major components and facilities for the Project is described. The specific locations of the various Project facilities are shown in the conceptual site layout plan as **Figure 2.3.1**.

2.3.1 Open Pit

The key component of the Project is the open pit, which is an excavation in the ground surface for the purpose of extracting the target mineral (in this case, gypsum), and which is open to the surface for the duration of active quarrying at the site.

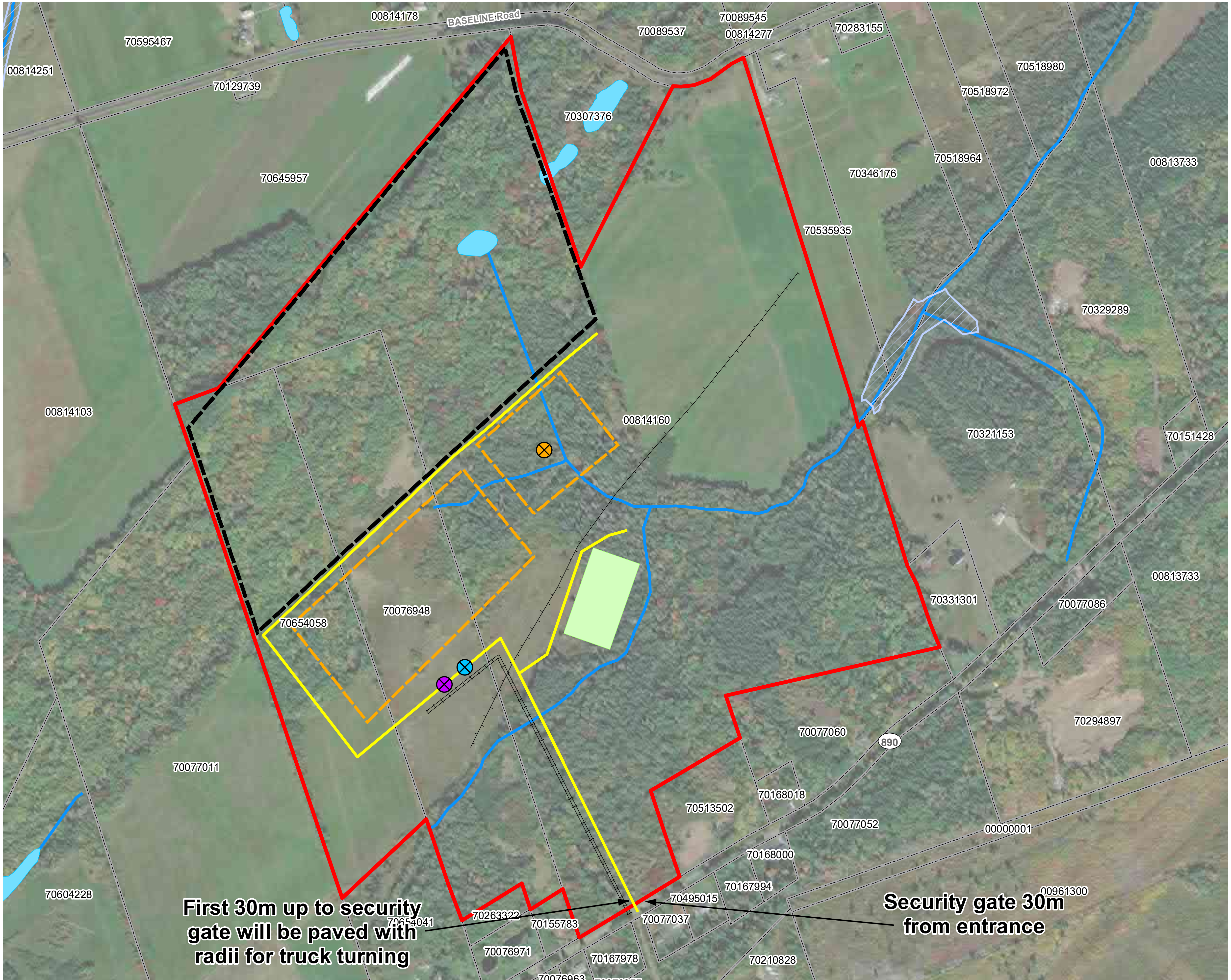
The layout of the open pit is developed to facilitate gypsum extraction. As mentioned in **Section 2.2** above, the gypsum deposit on the Glenvale site is located in the northern section of the property as shown in **Figure 2.3.1**. The location of the site features shown in **Figure 2.3.1**, such as the storage pads, access roads, and settling pond, are subject to change as the review process progresses. However, the quarry footprint is not expected to change.

The southern portion of the Upperton Formation consists of outcropping weathered gypsum, up to 40 m thick, 900 m in length and 100 m in width. The northern portion of the Upperton Formation hosts massive gypsum, 0 to 12 m thick under 5 to 11 m of overburden, 900 m in length, and 100 m in width. A narrow middle section of the Upperton Formation is cut by the melange zone, ranging in depth, width, and length, as described above.

The overburden material will be removed from the open pit footprint prior to gypsum extraction begins. Efforts will be undertaken to maintain treed buffers along property lines to the extent possible.

The open pit will be developed in as benches, with associated internal haul roads. A bench is a term used for each ledge that forms a single level of operation within the pit, above which mineral is quarried back to the bench face. Following blasting and/or rock breaking, the mineral is excavated in successive layers, each of which is a bench. Several benches may be in operation simultaneously in different parts of, and at different elevations in, the open pit.

Extraction in the open pit will occur up to 5 days a week (excluding weekends), for up to 12 hours a day during daytime, for approximately 200 days per year. The pit will be excavated by drilling and blasting successive benches, and removing the broken rock with a wheeled loader or excavator.



HAMMOND RIVER HOLDINGS LIMITED

PROPOSED GLENVALE GYPSUM QUARRY

CONCEPTUAL SITE LAYOUT PLAN

FIGURE 2.3.1

- Crusher
- Site Trailer
- Truck Scale
- Access Road
- Approximate position of Bell Aliant Cable Line
- Transmission Line
- Watercourse
- Gymsum Stock Piling and Material Management
- Project Development Area
- Property Boundary
- Quarry Footprint (Open Pit)
- Settling Pond
- Waterbodies
- Wetland (NBDELG 2021)

0 37.5 75 150 Meters

SCALE 1:5,500

N W E S

MAP DRAWING INFORMATION:
DATA PROVIDED BY DILLON CONSULTING LIMITED, CANVEC
SERVICE LAYER CREDITS: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), SWISS TOPO, OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

NOTE: THE ILLUSTRATED OFFSETS ARE ESTIMATES ONLY AND VARY DEPENDING ON THE PLANNED ACTIVITES FOR THE PROPERTY

MAP CREATED BY: RP/MEC
MAP CHECKED BY: JO
MAP PROJECTION: NAD_1983_CSRS_NEW_BRUNSWICK_STEREOGRAPHIC

DILLON CONSULTING

PROJECT: 22-4280

STATUS: FINAL

DATE: 2022-09-21

FILE LOCATION: K:\2022\224280\Product\Client\Glenvale\Figure 2.3.1 Conceptual Site Layout PlanNoSetBacks.mxd

Blasting is anticipated to occur up to 25 times per year as an annual average (excluding nights, weekends, and statutory holidays) using emulsion explosives managed by a licensed explosives contractor. Alternatively, where physical characteristics of gypsum allow and it is deemed economically viable, blasting may be substituted with mechanical rock breaking. The broken rock will be delivered to the on-site primary crusher.

The ultimate extent of the open pit at the end of quarry life will be approximately 20 ha. At its deepest point, the open pit will be approximately 45 vertical metres deep below ground surface (m bgs), compared to the current surface elevation of the site.

The bottom of the open pit will act as a sump to store water infiltrating into the pit while excavation work is being carried out at more elevated benches. The sump will be periodically dewatered when stored water meets discharge standards, and released to the receiving environment directly into a drainage channel that leads to a receiving watercourse.

2.3.2 Primary Crusher

Blasted gypsum rock extracted from the open pit will be crushed on-site to approximately 15-20 cm (6-8 inch) diameter size using a jaw-type portable, diesel-powered crusher. On average, the crusher is expected to operate approximately 1,000 hours per year during site operations, and its operation will occur only during daytime on weekdays.

Portable conveyors or stackers will be used to reduce on-site haulage of materials, where practical. Following crushing, the crushed rock will be directed to the gypsum storage area, either using a stacker or loaded directly onto haul trucks.

2.3.3 Gypsum Storage Area

Following primary crushing, the gypsum rock will be stored in the gypsum storage area while awaiting transportation to customers.

The storage area, as shown on **Figure 2.3.1**, will have an approximate area of 9 ha. It is anticipated that up to 50,000 tonnes of gypsum rock could be stored in the storage area at any given time. The gypsum storage pile(s) will remain open to the air, uncovered, as fugitive dust from 15-20 cm diameter materials is not expected.

Runoff from the gypsum storage area arising from precipitation will be collected and directed to a settling pond to allow for suspended sediments contained in the runoff to settle out, prior to its release to the natural environment.

2.3.4 Topsoil and Overburden Storage Area

To expose and extract the gypsum mineral, it is first necessary to remove surface materials including grubbings and soils (i.e., topsoil and overburden) above the gypsum deposit. Based on exploration and drilling work conducted on the site, it is anticipated that approximately 0-5 m of topsoil and overburden will need to be removed in the area of the open pit. Topsoil and overburden will be stored in a designated area on or near the storage area shown in **Figure 2.3.1**, for later use in progressive reclamation or site reclamation at the end of the Project life. Topsoil or overburden resulting from levelling or reshaping of other areas of the site will also be stored in these designated areas for future use. Storage piles of topsoil and overburden will remain open to the air, uncovered, since fugitive dust from these piles over time is not expected to require active management. Seeding of the storage piles using native species may be considered if there is a concern for erosion and sedimentation from the storage piles, though it is expected that vegetation will naturally grow on these piles over time.

As with the gypsum storage area, runoff from the topsoil and overburden storage area will be collected and directed to a settling pond or other sediment control structures to allow for settling or removal of suspended sediments that might be contained in the runoff prior to its release to the natural environment.

2.3.5 Facilities for Pit Dewatering and Runoff Management

The water management plan for the Project has not yet been fully developed and will evolve as site planning and design is conducted. The conceptual plans for pit dewatering and runoff management, as currently conceived at this early planning stage, are described below. These will be confirmed as part of the water management plan, as it is finalized.

Since the open pit will be located at depth below the surrounding ground elevation, it is expected that surface water (from precipitation and spring snow melt) as well as groundwater seepage will collect at the bottom of the open pit, thereby requiring periodic dewatering of the open pit so as to manage water volumes and minimize interference with operations occurring within it. To this end, the open pit will be developed in such a manner that the active bench being worked on to extract gypsum rock will be located at a higher elevation than the bottom of the open pit, so that the deepest portion of the open pit serves as a sump to store water infiltrating into the open pit until such time as it is removed by pumping. It is expected that most of the storage will be provided by the pit sump, which will require active pumping to control water levels.

Water contained in the deep portion of the open pit will be periodically pumped using one or more suitably sized portable pumps and flexible hoses directly to receiving drainage channels and ultimately released to the natural environment when the suspended solids content is suitable for direct discharge. Pumping will occur at a rate such that discharged water does not overwhelm the capacity of the receiving watercourse. Pumping will occur prior to (and following, as necessary) major precipitation events as well as at times when water levels may begin interfere with operations in the active working area. Water levels within the open pit will also be closely monitored and managed during the spring freshet and fall recharge period, with more frequent pumping as required.

A series of drainage channels will be constructed on-site to direct site runoff from active working areas of the site, and from storage areas, to the settling pond for further settling of suspended sediments.

Finally, at this time, it is expected that a water management (settling) pond will be constructed on-site, as shown on **Figure 2.3.1**, to temporarily store water from site runoff and pit dewatering prior to release to the natural environment. The specific location of the settling pond will be determined as part of the development of the water management plan for the Project, in parallel to the EIA review. The settling pond will not be lined with a compacted clay or geo-synthetic liner, since the only potential contaminant of concern in the stored water is suspended solids which will remain in the settling pond; this will allow some stored water (free of suspended sediments) to naturally infiltrate to groundwater through the bottom of the pond. The settling pond will be designed to store, combined with the pit sump, the volume of water generated by the 100-year, 24-hour rainfall event and to allow for a minimum 24-hour residence time for stored water, to enable natural, gravity-based settling of sediment suspended in the water. Water will not be discharged when downgradient infrastructure is already at capacity as a result of a major precipitation event.

The pond will discharge via an overflow weir or similar device, and with overflow water directed to a drainage channel to the natural environment. To maintain safe operation of the pond, water levels will be actively monitored and managed so as to prevent overtopping of the pond or an uncontrolled release of sediment-laden water, with excess water pumped, as necessary, to the natural environment, if water quality is suitable, or back to the open pit sump if suspended sediment concentrations are unsuitable for discharge. Collected sediments at the bottom of the settling pond will be removed, as required, by drawing down the settling pond to near dry conditions when weather conditions are suitable (e.g., during the dry summer months) and removing the collected sediments using an excavator.

Water released to the natural receiving environment will have a target concentration of total suspended sediments (TSS) of less than 25 mg/L above background levels in the receiving environment (measured as a monthly average of grab samples). Water will be released at a rate that does not overwhelm the capacity of the receiving structures or watercourse.

2.3.6 Truck Scale

A truck scale will be installed on-site to allow for weighing of incoming and outgoing trucks to determine the weight of their cargo. This is not only to enable a proper accounting of the weight of gypsum being sold to customers, but also to assist in meeting seasonal highway weight restrictions.

2.3.7 Portable Trailer/Office

A portable trailer will serve as a site office and lunch room at the Project site. There will be a separate portable trailer to serve as a lab for rock quality testing. Sanitary needs will be met by using bottled water and a portable toilet (managed and periodically serviced by a third-party company).

2.3.8 Electrical Power Supply

The electrical power needs for the Project are relatively modest, and electrical service is required only for the portable trailer/office. Electrical power will be supplied by constructing a short power line (approximately 500 m in length) to connect the portable trailer to the existing electrical grid located along Route 890 to the south of the PDA. The power line will consist of conventional wooden poles, conductors, and insulators, and will be similar to that required for residential service, providing single-phase alternating current at a voltage of 220 V. Electrical needs may be supplemented using solar panels or portable generators, as required.

Other than the short power line discussed above, no upgrades to existing transmission lines or distribution lines currently on the New Brunswick electrical grid are required for the Project.

2.3.9 Security Gate

Though the entire Project site will not be fenced, a security gate with appropriate fencing at and near the entry point to the site will be established to control access to the site. The security gate will remain locked to prevent unauthorized entry after hours, or during periods when the site is inactive. The security gate will be located on the access road to the site, approximately 30 m from Route 890.

A number of warning signs will be installed throughout the perimeter of the site to prevent unauthorized entry to the site by would-be trespassers and to warn individuals about the dangers that maybe present within the perimeter of the site (i.e., blasting, presence of moving heavy vehicles, large excavations, etc.).

2.3.10 Site Access and Internal Site Roads

As shown on **Figure 2.3.2**, access to the Project site will be provided via the New Brunswick provincial highway Route 1, the TransCanada Highway, Route 885, and Route 890.

Various internal site roads will be developed to access the active areas of the Project site and to facilitate the movement of materials on-site. The internal site roads will be unpaved, although consideration will be given to watering down the internal site roads or using other approved dust suppressants during extreme dry periods to reduce fugitive dust.

The initial 30 m of access road to the site (i.e., between Route 890 and the security gate) will be paved to minimize the transport of dust and mud from internal site roads onto the provincial highway network. The access road will be appropriately flared in both directions at an appropriate radius to facilitate the turning movements of heavy trucks entering and leaving the Project site.

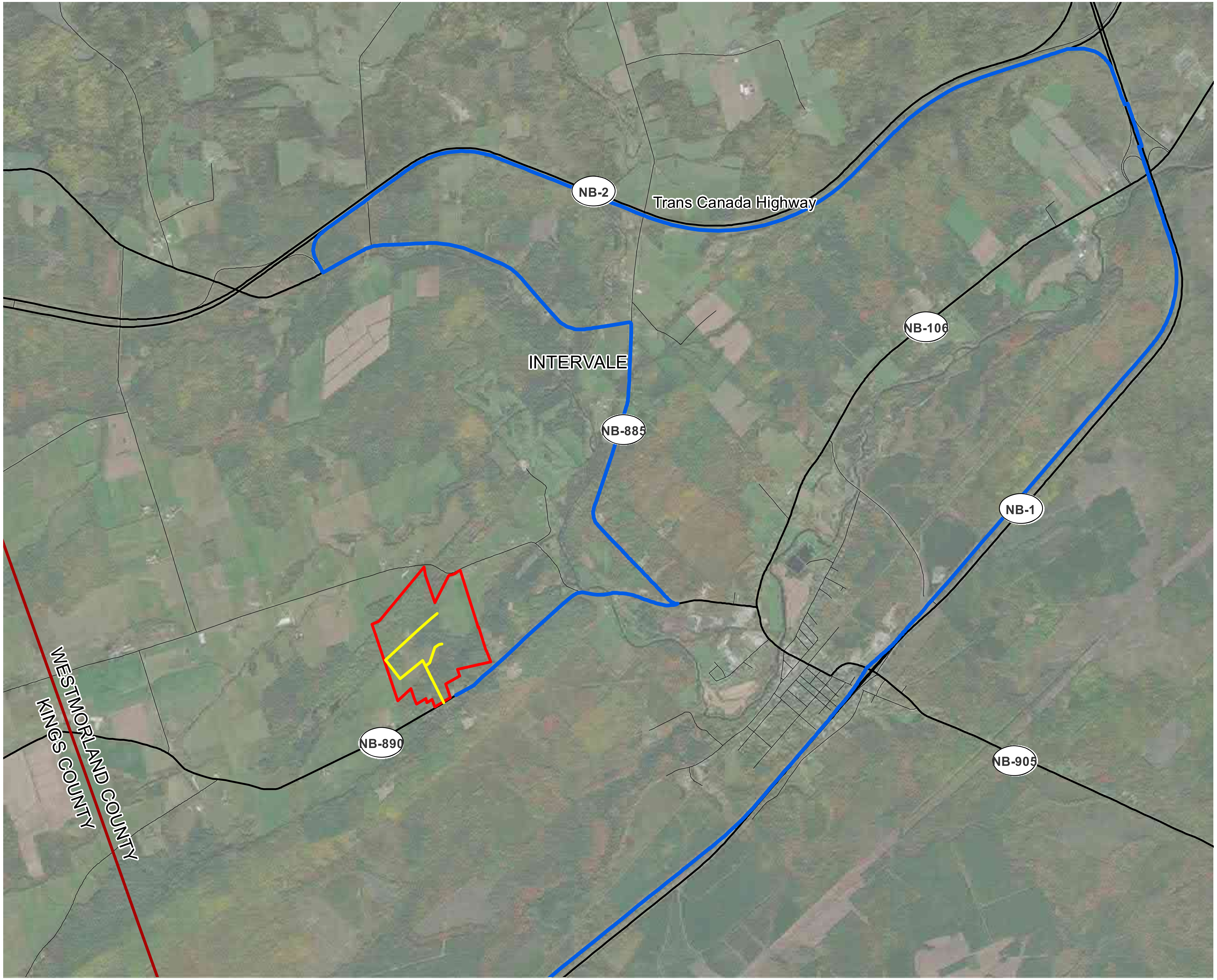
2.3.11 Proposed Transportation Route

The proposed transportation route from the site to the Irving Wallboard manufacturing facility in Saint John, NB and to other customers is shown in **Figure 2.3.2**. From the site access road, trucks will enter Route 890 in an easterly direction until the road intersects Route 885. Trucks will take Route 885 north until Intervale is reached; the trucks will continue on Route 885 in a west-northwest direction to the on-ramp for the TransCanada Highway. Travel will occur in an easterly direction, transferring to the provincial highway Route 1 where trucks will then follow the provincial highway system in a westerly direction to deliver the product to customers. This route is preferred since it enables the transportation of larger payloads for most of its length (i.e., 62,500 kg gross vehicle mass [GVM]) compared to other trucking routes. The route has been approved by the New Brunswick Department of Transportation and Infrastructure (NBDTI) for the weight bearing capacity, including the bridges crossing the North River. Hammond River Holdings will work with NBDTI on future route changes, as required.

2.3.12 Hazardous Materials

There are no chemicals required for the processing of materials for the Project. Diesel exhaust fluid (DEF) is stored on site in 4 litre containers and added to equipment, as needed. No other chemicals will be stored on the Project site.

Fuel for the crusher, mobile equipment, and trucks on-site will be supplied by third party owned mobile tankers who will refuel mobile equipment on-site on a daily basis, then leave. There is no planned fuel storage on-site at this time. In the unlikely event of a future decision to store fuels on-site, they would be stored in a self-contained tank(s) equipped with secondary containment ("con-tanks") owned, operated, and serviced by third parties. Tanks would be licensed under the New Brunswick *Petroleum Product Storage and Handling Regulation* if the total site storage capacity exceeds 2000 liters. In such an unlikely case, no more than 10,000 litres of fuel would be expected to be stored on-site at any given time.



HAMMOND RIVER HOLDINGS LIMITED
PROPOSED GLENVALE GYPSUM QUARRY

PREFERRED TRANSPORTATION ROUTE
FIGURE 2.3.2

- Highway
- Road
- Selection of Preferred Transport Route
- Site Road
- Counties
- Project Development Area

0 0.25 0.5 1 Kilometers SCALE 1:35,000

N W E S

MAP DRAWING INFORMATION:
DATA PROVIDED BY DILLON CONSULTING LIMITED, CANVEC
SERVICE LAYER CREDITS: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), SWISS TOPO, OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

MAP CREATED BY: RP
MAP CHECKED BY: JO
MAP PROJECTION: NAD_1983_CSRS_NEW_BRUNSWICK_STEREOGRAPHIC

DILLON CONSULTING

PROJECT: 22-4280
STATUS: FINAL
DATE: 2022-09-21

FILE LOCATION: K:\2022\224280\Product\Client\Glenvale\Figure 2.3.2 Preferred Transportation Route.mxd

2.3.13 Mobile Equipment

Trucks and other mobile equipment will be located on site to assist with construction activities and subsequent operation. A summary of the anticipated needs for mobile equipment on-site during construction and operation is provided in **Table 2.3.1**.

Table 2.3.1: On-site Mobile Equipment Use during Construction and Operation

Equipment Type	Number Used
45-tonne excavator	2
35-tonne articulated rock truck	5
D6-sized bulldozer	1
980-sized front end wheeled loader	1
Water truck	1
Portable jaw crusher	1
Air track drill (for blasting)	1

In addition, transportation of gypsum rock from the Project site will be accomplished using dump trailers operated by a third party.

2.4 Description of Project Phases and Activities

A description of the various phases of the Project, and the activities associated with each phase, is provided in this section.

2.4.1 Construction Phase

The construction phase will be initiated following the completion of the EIA review and the receipt of all required permits, approvals, licenses, authorizations, or leases for the Project. A high-level description of each of the activities associated with the construction of the Project is provided below.

2.4.1.1 Vegetation Clearing

Most of the site was cleared of mature vegetation in 2021 for the purpose of logging; therefore, clearing of the site will be relatively modest and straightforward and will focus on the removal of immature trees, shrubs, and other ground vegetation to make way for the Project facilities. Limited clearing of immature vegetation present in the active areas at the southern portion of the site (e.g., storage area and other active areas) will occur first so as to allow for the preparation of the storage area prior to removing topsoil and overburden in the open pit area. Efforts will be made to maintain as much mature vegetation that remains along the edges of the site as possible, so as to act as a tree buffer. Clearing of immature vegetation in the open pit area will then be initiated when the storage area has been developed, and will occur progressively in phases as the size of the open pit increases over time during operation.

Limited clearing will be completed largely using a bulldozer and excavator for non-merchantable materials; and by forest harvesting machinery for merchantable material. Mature trees along the perimeter of the site will be maintained as a tree buffer to the extent possible, and as much mature vegetation and trees as possible will be maintained along wetlands and watercourses that are not required to be disturbed for the Project (particularly at the southern and of the site) and under the conditions of a watercourse and wetland alteration (WAWA) permit. Clearing near watercourses and wetlands, if necessary, will be conducted manually, leaving the stumps behind to prevent soil erosion.

Clearing activities will be conducted outside of normal bird breeding season (April 8 to August 28) to the extent possible, to prevent the undue disturbance of migratory birds or their nests (including those that nest in trees as well as on the ground). Should clearing be required within this season, these areas will be surveyed to determine if nesting is occurring within these areas, and nests flagged for avoidance until the young have fledged.

All cleared merchantable timber will be sold, but non-merchantable cleared vegetation will remain on-site and be used as fill material during reclamation and closure.

Erosion and sedimentation control techniques will be employed throughout the clearing activity as well as for subsequent construction activities discussed below, as required, to minimize erosion of exposed areas and sedimentation in surface water runoff on the site. Dust suppression will also be employed during construction activities to minimize the potential environmental effects of fugitive dust to offsite locations.

2.4.1.2 Grubbing

Grubbing includes the removal and disposal of stumps and roots remaining after clearing. Grubbing will be conducted using an excavator or bulldozer to remove the roots and stumps of cleared vegetation. The entire cleared portion of the site will be grubbed, progressively as the size of the open pit increases over time during operation.

Grubbings will be stored on-site in an inactive area and used as fill material during construction or reclamation and closure.

2.4.1.3 Levelling and Contouring

Location of the surface facilities will be located on the central to southern half of the site (as shown in **Figure 2.3.1**); the surface will be prepared by levelling of the areas using mobile equipment such as excavators, front end loader, bulldozer, and articulated dump trucks. Since the quarry area on the northern half of the site will eventually be stripped of topsoil and overburden, levelling of this area is not required.

Contouring and shaping of the levelled areas will be conducted to maintain stable slopes and facilitate proper drainage to the drainage channels and settling pond.

2.4.1.4 Construction of Storage Areas

Following grading and levelling, the sub-base for the storage area will be prepared as necessary using some of the native soils from the levelling activities on-site, supplemented by materials from approved local borrow sources where required. If the natural soils are not of a suitable nature to be used as the sub-base, locally-sourced till or clay will be used. A geo-synthetic liner is not required underneath the storage area, given the inert nature of gypsum.

The final storage area will be graded to create the desired grade for drainage capture, and drainage collection works for the area will be installed.

2.4.1.5 Removal and Stockpiling of Topsoil and Overburden

The overburden in the open pit area generally consists of a veneer of organic matting and topsoil over till. The overburden thicknesses generally range from less than 0 m to 5 m in depth below ground surface. Topsoil and overburden removal in the open pit area will be initiated during construction, and will continue progressively throughout operation of the Project as the size of the open pit increases over time.

Topsoil will first be removed and stored in a designated location at the storage area. Following this, overburden will be excavated until the underlying sulphates are reached, and similarly stored in a designated location at the storage area. Topsoil and overburden will be stockpiled for future reuse during site reclamation at the end of quarry life.

Sediment control fencing will be installed and maintained at stockpiles that are up-gradient of a watercourse to prevent the down-slope transport of sediment into watercourses.

2.4.1.6 Construction of Perimeter Channels, Drainage Channels, and Settling Pond

Engineered perimeter channels will be constructed along the perimeter of the site to divert non-contact surface water from the surrounding watershed and mitigate inflow onto the Project site. Similarly, a number of drainage channels will be constructed on-site to direct surface runoff generated within the Project site to the settling pond. These features are intended to minimize the amount of water to be collected and to prevent the release of potentially sediment-laden water from entering watercourses and wetlands.

The settling pond will be excavated using an excavator or backhoe, and excavated soils will be temporarily stored for reuse on-site. A compacted clay or geo-synthetic liner underneath the settling pond is not expected to be required, given that gypsum is inert and the sediments contained in the settling pond are likely of a similar composition to surficial soils and gypsum.

On-site storage facilities (including the settling pond and open pit sump) will be sized to store the runoff volume generated by the 100-year, 24-hour rainfall event. It is anticipated that the open pit may be used for supplemental storage during periods of intense rainfall. For example, during high intensity rainfall events (e.g., 100-year storm), pumping from the open pit will cease until rainfall has subsided and sufficient storage is available in the settling pond.

Sizing of the settling pond and outlet facilities will be completed using hydrologic/hydraulic dynamic simulation and will consider the impacts of climate change. The hydraulic operation of the pond will be designed so that sufficient storage capacity is available to allow for a minimum 24-hour residence time for stored water under normal operating conditions (include, but are not limited to overburden movement, blasting, extraction, crushing, rock transportation on site and rock loading). Overflow from the settling pond will be released via an armoured weir or similar outfall device to an engineered channel that discharges to one of the small watercourses on the southern end of the site. The outflow channel will be designed to limit discharge velocities and protect the downstream natural channels from erosion.

The perimeter channels, drainage channels, and settling pond will remain in place throughout the construction and operation phases of the Project.

2.4.1.7 Development of Internal Site Roads, and Paving of Access Road

Internal site roads connecting the various areas of the Project will be developed and/or upgraded as necessary to meet the Project needs. Native soils and gravel from other earth moving activities on the Project site will be used for road development, supplemented as necessary by gravel and crushed rock sourced from approved local borrow pits.

Finally, to limit the dust generated by trucks to nearly background levels, the first 30 m of the site access road will be paved (Golder 2010, p.2). The end of the access road will be flared to a suitable radius to facilitate truck turning movements.

2.4.1.8 Installation of Truck Scale, Portable Trailer/Office, and Security Gate

Once surface facilities have been developed, the truck scale will be installed. A portable trailer to be used as a site office/lunch room will be brought to the site and installed. The security gate and other security signage will be installed.

2.4.2 Operation Phase

The operation phase will begin immediately following the completion of construction activities, for an approximate duration of 10 years or until the mineral resource has been depleted. Operation of the Project is relatively straightforward, and most activities take place within the open pit. A brief description of the activities that will be conducted during the operation phase is provided below.

2.4.2.1 Open Pit Operation (Drilling, Blasting, Excavation, Hauling, Crushing)

Open pit operations will include drilling, blasting, excavation, hauling of rock, and crushing. Open pit operations (e.g., blasting, excavation, crushing) will be carried out up to 5 days a week (excluding weekends), for up to 12 hours a day during daytime, for approximately 200 days per year. Activities in the open pit will be as follows.

- Following construction, the open pit will be excavated by drilling and blasting successive benches and removing the broken rock with a hydraulic excavator and/or wheeled loaders.
- Blasting will occur approximately 25 times per year as an annual average (excluding nights, weekends, and statutory holidays) using explosives by a licensed blasting contractor.
- The broken sulphate rock will be excavated from the active pit area and delivered to the portable crusher.
- Surplus rock will be delivered to the stockpile area.
- Gypsum will be loaded into the portable crusher and will be crushed to an approximate diameter of 15-20 cm.

2.4.2.2 On-site Transportation, Storage, Loading, and Transportation to Customers

Following crushing, the operations on the site are limited to the on-site hauling, storage, loading, and transportation of gypsum to customers. These activities will be as follows.

- Crushed gypsum will be loaded onto articulated rock trucks using a wheeled loader or a portable conveyor and trucked to the storage area.
- Gypsum will be stored on the storage area for a short period of time (up to a few months), pending transportation.
- A wheeled loader will load crushed gypsum from the storage area onto transport trucks in preparation for transportation.
- Gypsum will be transported to customers using the preferred transportation route shown in **Figure 2.3.2**.

Approximately 300,000 t/yr of gypsum will be transported to customers. Assuming the use of trucks carrying approximately 32 tonnes of material at a time, and assuming 250 days of year of potential trucking, approximately 35-45 trucks per day on average would be required to carry the annual production of natural gypsum to markets.

While open pit operations (i.e., excavation, crushing) will be limited to up to five days a week during weekdays (up to 12 hours a day during daytime) for up to 250 days a year, loading of trucks and transportation of gypsum to customers could occur throughout the day, year-round, as highway restrictions permit.

2.4.2.3 Surface Water Management

Surface water and groundwater infiltrating into the open pit will be directed to a sump established in bedrock at the bottom of the open pit, below the working bench, and periodically pumped directly to receiving waters to manage water levels within the pit. In rare situations where dewatering of the open pit is required to maintain acceptable water levels in the pit but suspended sediment concentrations are at levels unsuitable for direct discharge to the environment, consideration will be given to directing the water from the open pit to the settling pond.

All other surface water from runoff on the site will be directed via constructed drainage channels to the settling pond. Water will be directed into a settling pond to allow for the natural gravity sedimentation of suspended sediments contained in the surface water prior to release to the environment. Overflow from the settling pond will be discharged to a drainage channel using via an armoured weir or similar outfall device, to a drainage channel that releases to a small watercourse located on the southeastern portion of the site. Periodic monitoring of pH and suspended solids concentrations in the surface water will be conducted to verify that water quality meets the target discharge concentration of less than 25 mg/L of total suspended solids above background levels of the receiving watercourse, measured as a monthly average of grab samples.

2.4.3 Reclamation and Closure Phase

The New Brunswick *Mining Act* requires that a Reclamation and Closure Plan be developed for the Project as part of it obtaining a mining lease under that Act.

The conceptual approach to completing reclamation and closure of the Project as currently conceived at this early stage of Project development includes:

- progressive reclamation of disturbed areas;
- removal of all materials and surface facilities on the site;
- re-contouring and reshaping the site;
- re-vegetating the site as much as possible with species native to the local area; and,
- allowing the open pit to fill with water from natural precipitation (over time).

Progressive reclamation refers to areas that have been disturbed by site activities will be reclaimed as the Project proceeds, rather than waiting until the Project is completed, thereby promoting the site to return to near natural conditions once operations cease. Progressive reclamation activities will hydroseeding and contouring of disturbed areas, where applicable. The development of the quarry layout has not been fully realized at this point; however, the layout will facilitate gypsum extraction and allow for progressive reclamation, to the extent possible. Thus, reclamation activities will occur in parallel with extraction activities.

Following the completion of the operation phase, and prior to allowing the open pit to fill with water, its edges will be reshaped to an appropriate slope to allow for safe entry and egress of the pit lake by animals or humans. Additionally, appropriate signage and other safety measures will be put in place to warn individuals about the potential safety hazards arising from the presence of the pit lake.

This conceptual plan will be updated as part of the process to obtain a mining lease for the Project under the *Mining Act.*

High-level details of the activities to be conducted during the reclamation and closure phase are provided in the sub-sections that follow.

2.4.3.1 Decommissioning

The surface facilities and infrastructure will then be decommissioned and removed, including the removal of all pumps, hoses, portable crusher, portable office/trailer, truck scale, mobile equipment, and other machinery. Site access roads, internal roads, power supplies, and other utilities will be decommissioned, unless required for closure of the site.

2.4.3.2 Reclamation

Reclamation will involve the restoration of the Project site to as near natural conditions as possible. In general, disturbed areas of the site including the storage areas and other active areas of the site will be graded and shaped. The settling pond will either remain as a water feature or be infilled with on-site fill material, and the site will be levelled using mobile equipment. Slopes will be graded to merge naturally into adjacent undisturbed areas. Grading may include decommissioning drainage channels and other water management facilities that are no longer needed, or enhancing them to provide natural swales for channelling surface water into nearby watercourses. The former storage areas and other active areas of the site will be covered with stored overburden, then covered with topsoil.

Since gypsum rock will be trucked off-site during operation, there will be insufficient material remaining on site to fill the open pit at closure, and trucking in of fill material for such purpose is not economically feasible. As such, other than for some minor residual materials (e.g., grubbings, off-specification gypsum) not used on-site that will be disposed of in the former open pit, it will not be possible to reclaim the open pit other than as an open-water landscape feature once a pit lake has been established. Similarly, there are no reclamation options for the bare rock faces, and some of the upper benches of the open pit may remain exposed above the pit lake water level. Reclamation will consider implementing feasible measures to mitigate potential hazards to humans and wildlife (e.g., risks potentially posed by vertical rock faces in the open pit, or from deep water in the open pit with no easy exit), subject to further definition as part of reclamation planning throughout the Project life.

The focus for reclamation will be to encourage natural re-vegetation of the site, with limited intervention. Over time, some natural habitats will emerge, such as rock outcrop on the pit rim and walls, possibly wetland habitat on shallow, submerged rock terraces, and upland forest in areas surrounding the pit. Exposed areas will be re-vegetated with native species of hydroseed as necessary to accelerate natural regrowth. Once the areas are stable, it is expected that native shrubs will quickly invade the site, providing natural vegetation cover for the site.

2.4.3.3 Closure

During closure, the surface water drainage channels on the site as well as the settling pond will be removed, but the perimeter channels along the edges of the site will be left in place. If possible, drainage channels within the site itself will be directed towards the open pit to direct runoff to the open pit to enable its filling with water.

2.5 Project Schedule

The anticipated Project schedule is as follows:

- **Construction**: extending for a period of approximately four months, anticipated to begin in the fourth quarter (Fall) of 2023 (subject to the receipt of all approvals and permits required for the Project);
- **Operation**: beginning in approximately the first quarter of 2024, and lasting for approximately 10 years or until the mineral resource has been depleted; and,
- **Reclamation and closure**: to be initiated following the completion of operations at the site, with decommissioning and reclamation of the surface facilities at the site for an anticipated duration of six months following operation.

2.6 Workforce

The workforce required for constructing and operating the Project is relatively modest, given the simple nature of the Project and its intended operations.

During construction, activities will be carried out largely by a third-party heavy equipment contractor who will implement site clearing, earth moving, leveling, contouring, storage area preparation, and development of water management features, and related construction activities for the Project. The contractor will work under the supervision of a Hammond River Holdings representative (or designate). It is expected that the contractor would be able to carry out these construction activities with its existing staff (although additional staffing is possible).

During operation, a small workforce is required on-site while quarrying and related activities are taking place. It is expected that approximately 6-10 personnel would be located on-site at any given time (either Hammond River Holdings employees, or contractors, or both), supplemented by an explosives contractor and trucking contractors involved in the trucking of gypsum to customers.

Reclamation and closure activities will be conducted by the same workforce and contractors as during the operation phase, for a short period of time until the site is reclaimed and ultimately abandoned.

2.7 Emissions and Wastes

The anticipated emissions and wastes associated with the Project are discussed in this section. Hammond River Holdings, through the conditions of the various permits and approvals it will receive to enable construction and operation of the Project, will meet or exceed the compliance standards outlined in applicable regulations and guidelines with respect to waste, emissions and discharges from the Project. Where no such standards exist, industry best practices will be adopted, where applicable. Emissions and wastes will be reduced through best management practices, following applicable legislation, and mitigation planning including the development of an Environmental Protection Plan (EPP).

2.7.1 Air Contaminant Emissions

Air contaminant emissions from the Project will mostly occur during the construction and operation phases. The potential air contaminant emissions of concern include primarily particulate matter (PM, including its common size fractions PM_{10} and $PM_{2.5}$) from fugitive sources (e.g., unpaved roads, crushing, material handling, storage piles) as well as combustion gas emissions such as carbon monoxide (CO), nitrogen oxides (NO_X), and sulphur dioxide (SO_2) from the combustion of fossil fuel by site equipment. Given the relatively straightforward nature of the Project, measurable emissions of other air contaminants (other than greenhouse gases, discussed below in **Section 2.7.2**) are not expected.

Emissions during construction are generally related to the generation of dust from earth moving activities and unpaved roads, and routine combustion gas emissions from construction equipment. Equipment used for construction will generally consist of dump trucks, excavators, wheeled loaders, bulldozers, and other mobile equipment, similar to what may be seen on many other commercial or industrial construction sites. Control measures, such as use of water sprays on roads during dry periods or other dust suppression techniques, will be used as required to reduce the fugitive dust, and routine inspection and maintenance of construction equipment as well as the implementation of a no-idling policy will reduce exhaust fumes.

Though the Project site is relatively distant from nearby residences and within a tree buffer in some areas surrounding the PDA (thereby reducing the potential off-site transport of dust), the timing of construction activities will also be important to avoid undue nuisance to off-site receptors. It is planned to limit intrusive activities to daylight hours during weekdays only. The burning of waste brush/slash material or grubbings will not be permitted.

Emissions during the operation phase are expected to be largely similar to those arising during construction, consisting primarily of dust from crushing, material handling, storage piles, and unpaved roads, some minor blasting residues during blasting events (once or twice per week for an instantaneous period), as well as routine combustion gas emissions from the burning of fossil fuels used in trucks and mobile equipment. Equipment used during operation will be similar to that used during construction, including trucks, excavators, wheeled loaders, the primary crusher, and other mobile equipment; equipment will be routinely inspected and maintained in good working order to reduce combustion gas emissions, and the implementation of a no-idling policy will further avoid emissions. Active operations will be limited to daytime during weekdays only, up to 200 days per year.

Water sprays or other dust suppressants will be used on internal site roads during dry periods as required to reduce fugitive dust, and if required, consideration will be given to using water sprays on the primary crusher if dust levels become of concern. Water for spraying roads will be sourced from the pit sump and/or settling pond. Though the gypsum storage pile(s) will be an active area that may generate some limited dust during material handling, dust emissions from stored gypsum (with a diameter of 15-20 cm) are not expected to be substantive.

Dust emissions from the topsoil and overburden storage piles are not expected since these will become naturally vegetated over time, thereby minimizing soil erosion and dust from wind entrainment. Similar to construction, the Project site is relatively distant from nearby residences, and the presence of a tree buffer will reduce the potential for off-site transport of dust. As well, dust-producing site activities will be limited to daytime during weekdays only so that the Project does not cause undue nuisance to off-site receptors. There may be nominal combustion gas emissions from delivery of supplies and equipment to the site and transport of gypsum from the site, which in general should not be measurable above background levels.

Potential air contaminant emissions during reclamation and closure will be similar in nature to, but lower in magnitude and duration than, emissions associated with construction of the Project.

An assessment of the environmental effects of the Project on the atmospheric environment is provided in **Section 5.2**.

2.7.2 Greenhouse Gas (GHG) Emissions

Greenhouse gas (GHG) emissions from the Project will mostly occur during construction and operation, consisting of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), as carbon dioxide equivalents (CO_2e), from fossil fuel combustion in trucks and mobile equipment. Given the relatively straightforward nature of the Project, these emissions are not expected to be substantive.

The Project will interact with the atmospheric environment through the release of GHGs into the atmosphere as described above for air quality. An assessment of the environmental effect of the Project on the atmospheric environment due to Project-related GHG emissions is provided in **Section 5.2**.

2.7.3 Noise and Vibration Emissions

Noise emissions from the Project will occur primarily during construction and operation, and are generally associated with the operation of mobile equipment, the primary crusher, material handling operations, and blasting activities. Vibration will also occur from these same operations, although to a lesser extent during the construction phase than during operation.

Noise and vibration during both construction and operation will be intermittent, as equipment is operated on an as-needed basis while site operations are taking place. Noise sources will be mitigated through the use of mufflers on equipment, carrying out routine maintenance of equipment to maintain it in good working order, and limiting noise producing operations to daytime during weekdays only. The presence of a tree buffer will reduce the potential off-site effects of noise and vibration emissions such that the Project does not cause undue nuisance to off-site receptors.

In addition to the above potential sources of noise and vibration emissions during construction, further noise and vibration emissions could result during operation due to blasting, crushing, and material handling activities within and near the open pit. Blasting activities will be limited to approximately 25 blasts per year as an annual average (excluding nights, weekends, and statutory holidays), and a communication plan will be developed for residents who wish to be notified. Crushing operations will be conducted mostly within the open pit to minimize noise levels. Given that blasting, crushing, and material handling operations within the open pit will be conducted at depth (i.e., on benches within the pit and below the surrounding ground surface, rather than at ground surface), topography and the presence of the pit walls will further reduce the off-site transport of noise emissions. Pre-blast surveys will be conducted at the nearest residences, and blasts will be periodically monitored using seismographs, to confirm that concussion noise levels do not exceed a peak pressure level limit of 128 decibels (dBL) and that peak particle velocities (PPV) remain within 1.25 cm/s, as a best industry practice for quarry operations.

An assessment of the environmental effects of the Project arising from noise and vibration emissions is provided in **Section 5.2**.

2.7.4 Liquid Wastes

Given the relatively simple nature of the Project, liquid wastes (except for site runoff, discussed below in **Section 2.7.5**) are not expected to be generated during each phase of the Project. There are no transformation processes associated with the construction or operation of the Project, and the Project is not a consumer or generator of water or liquid wastes. There will be no permanent buildings, permanent fuel storage, or equipment maintenance on-site; as such, the generation of liquid wastes (including liquid hazardous wastes) from the Project is not expected. Should the decision be made to install a septic system on-site, it will be designed to meet the requirements of the *Public Health Act*. The septic system would be removed during the reclamation phase.

2.7.5 Pit Dewatering and Surface Runoff

Surface runoff may result during construction and operation of the Project due to natural precipitation (including during the spring freshet) falling on the Project site, thus requiring management. Additionally, water from periodic dewatering of the open pit will require management during operation. As discussed in **Section 2.4.1**, the Project will be leveled and contoured during construction, and on-site drainage channels will be constructed to convey water from the portions of the site with exposed soils to the settling pond for settling prior to natural discharge.

Further, the deepest part of the open pit will act as a sump for containing precipitation and seepage water that enters the pit (with the active working area of the quarry at a higher elevation so that pit water does not interfere with site operations). The sump will need to be periodically pumped as water levels rise, if water quality is suitable for direct discharge, to the perimeter ditch.

All other surface runoff on-site will be directed to the settling pond to allow for suspended sediments to settle via gravity sedimentation prior to overland release to the receiving environment. Released water will be periodically tested to verify that water quality meets the target discharge concentration of less than 25 mg/L of total suspended solids above background levels, measured as a monthly average of grab samples. Other contaminants in released water are not expected.

The water management plan for the Project will be developed in parallel to the EIA review (as part of site engineering), with these goals in mind. Additional measures to minimize potential effects due to surface runoff will be detailed in the EPP. An assessment of the environmental effects of the Project on water resources is provided in **Section 5.3**.

2.7.6 Solid Wastes

Given the relatively simple nature of the Project as a quarry with no transformation processes on site, few solid wastes are expected to be generated from the Project.

During construction, topsoil and overburden will be removed from the open pit area and stored for later use in site reclamation. Materials from earth moving activities on the remainder of the site during grading and levelling will be reused in shaping and contouring the site. Grubbings and non-merchantable timber from clearing will be stored for future use as fill during site reclamation (e.g., partial filling of the open pit at closure). There will be no waste rock expected from the Project.

During operation, material excavated from the open pit as gypsum will be trucked to customers for production of wallboard. Any excavated rock that does not meet product specifications would be stored on-site for other uses and/or reused in site reclamation (with possible disposal in the open pit at closure). There is no physical or chemical transformation occurring on-site that would result in the generation of solid wastes.

Any garbage and other refuse would be managed by storage in an on-site dumpster and periodically trucked away by a waste disposal contractor for disposal at the Eco360 Waste Management Facility in Berry Mills, NB.

2.8 Alternative Means of Carrying out the Project

This section discusses the various alternative means of carrying out the Project that are technically and economically feasible that have been considered, and their environmental effects (as applicable).

2.8.1 Alternative Project Locations

The Project location is fixed by the location of the gypsum mineral deposit. As the location of the mineral deposit is on the subject property and not elsewhere, there are no technically or economically feasible alternative locations for this Project as currently conceived. The Project is located at a suitable distance from the North River and Petitcodiac River and in a relatively sparsely populated rural community, representing favourable characteristics from a site selection perspective.

However, as mentioned previously, other potential gypsum deposits that may be explored for future consideration by Hammond River Holdings.

2.8.2 Alternative Extraction Methods

Since the gypsum mineral deposit at the Project site is near surface with overburden thickness generally from 0 to 5 m thick, surface extraction is the only technically and economically feasible means of accessing the gypsum deposit. Underground gypsum extraction is not technically and economically feasible. Thus, in terms of the quarrying method, there are no technically and economically feasible alternative means of carrying out the Project.

2.8.3 Alternative Locations for Surface Facilities

The principal factor that governs the location of the surface facilities (including the portable crusher, storage area, and water management facilities) is the distance between them and the open pit. Minimizing the distance between site operations reduces the distances for hauling and conveying material from the pit to the other on-site facilities, and resulting in more efficient movement of materials on-site. Given that the surface area of the Project site is relatively compact for the required operations, the surface facilities will be located as close as possible to the open pit and in a configuration as was conceptually shown in **Figure 2.3.1**. This configuration also affords the ability to maintain tree buffers (where they already exist) along the perimeter of the site as well as around watercourses and wetlands on the southern end of the site, thereby minimizing the footprint of the Project and associated environmental effects.

Though it could be technically feasible to construct surface facilities elsewhere, the increased hauling distance between the open pit and other possible locations would not be economically feasible in comparison to the Project as planned.

Thus, in terms of the location of the surface facilities on the site, there are no technically and economically feasible alternative means of carrying out the Project.

2.8.4 Alternative Water Management Methods

Given the relatively simple nature of the Project and its related activities, water management and treatment requirements for the Project are straightforward. Gypsum, by its nature, is an inert mineral that does not result in the generation of acid rock drainage or the related leaching of trace metals; thus, the primary objective of the water management facilities for the Project is to allow for the gravity settling and removal of suspended sediments contained in pit water and site runoff so that their release does not result in undue siltation of nearby watercourses and wetlands.

While there are other methods available for removal of suspended sediments in water that would be technically feasible (including filtration, centrifuging, decantation, or other methods), their removal by gravity sedimentation in a suitably sized sump and settling pond (with verification of discharged water quality through periodic grab sampling and analysis for total suspended sediments and pH) is the most technically and economically feasible means of carrying out the Project.

2.8.5 Alternative Options for Reclamation and Closure

Hammond River Holdings will consider in detail various options to achieve reclamation and closure of the Project site at the end of quarry life to meet the requirements of the *Mining Act*. The conceptual reclamation and closure plan, described in **Section 2.4.3** above, describes the conceptual approach to completing reclamation and closure of the Project as currently conceived at this early stage of Project development. The conceptual reclamation and closure plan includes removal of materials and surface facilities on the site, re-contouring and reshaping the site, re-vegetating the site as much as possible with native species, disposal of unusable fill (from grubbings, non-merchantable timber, and other soils) in the open pit, and allowing the open pit to fill with water from natural precipitation (over time). This conceptual plan will be updated as part of the process to obtain a mining lease for the Project under the *Mining Act*, which requires a reclamation and closure plan to be developed as a pre-requisite to obtaining a mining lease.

Alternative methods of reclaiming the site would normally include the steps mentioned above in addition to giving consideration to backfilling the open pit with stored fill material or surplus rock. However, given that the majority of the gypsum deposit will have been quarried and removed from the site for other purposes, there would be insufficient material on-site to fill the open pit. Bringing in fill material from other sources to fill the open pit would not be economically feasible.

As such, subject to confirmation through the development of the Reclamation and Closure Plan for the Project, there are no technically or economically feasible alternatives to accomplish reclamation and closure of the Project.

2.8.6 Alternative Transportation Routes

The Project is nestled between two major transportation routes, the TransCanada Highway located to the north, and Route 1 located to the south of the Project site. Baseline Road will be used to gain access to either of these routes.

The proposed transportation route was shown in **Figure 2.3.2** and discussed in **Section 2.3.10**. As this Project is in the early stages of formulation, consideration will be given to other transportation routes, including using the Manhurst Cross Road and connection of Old Post Road to Route 1.

2.9 Environmental Planning and Management

Hammond River Holdings is committed to developing the Project in an environmentally responsible manner consistent with good environmental management principles and retaining the rural character of the community while meeting the market demand for gypsum. To this end, Hammond River Holdings will develop and carry out the Project in a manner that avoids or minimizes the adverse environmental effects of the Project, and enhances positive ones, in a manner that complies with applicable laws and regulations.

Several environmental protection and management measures will be implemented to guide the construction, operation, and reclamation and closure of the Project, as follows.

- Employing good planning, design, and management practices to comply with regulated and/or applicable industry standards to satisfactorily deal with environmental risks such as unusual weather events, flooding, and erosion.
- Siting facilities to avoid sensitive areas such as wetlands, watercourses and important habitat types, where possible, and maintaining as much of a mature tree buffer as possible surrounding these features.
- Minimizing the footprint of Project facilities and activities to consequently reduce the amount of disturbed land, wetlands, and water resources.
- Employing good planning, design and management practices to satisfy standards and objectives for air contaminant emissions, noise, vibration, and surface runoff.
- Implementing progressive environmental protection, mitigation, and management strategies that avoid or minimize adverse environmental effects, and maintain or enhance positive effects.
- Preparing and implementing an Environmental Protection Plan (EPP), which will contain mitigation measures to avoid and reduce potential adverse environmental effects that might otherwise occur from routine Project activities, including emergency response and contingency procedures. The EPP will include procedures related to, but not limited to, the following:
    - management of emissions and noise;
    - management of surface water runoff;
    - heritage resources (including procedures for chance encounters of heritage resources during construction);
    - erosion and sediment control;
    - spill prevention and management;
    - transportation; and,
    - training and awareness.

- Preparing and implementing Project-specific emergency response and contingency procedures as part of the EPP to advise Project personnel on how to implement specific actions to respond to accidents, malfunctions, or unplanned events.
- Completing Indigenous and public/stakeholder engagement, as described in **Sections 9.0** and **10.0**, such that, wherever possible, concerns about the Project are accommodated in its design, construction, operation, and reclamation and closure.

3.0 Overview of Environmental Setting

The Project is located in southeastern New Brunswick approximately 4 km northwest of the village of Petitcodiac, New Brunswick, within the Petitcodiac River watershed. A high-level overview of the environmental setting for the Project is provided in this section.

3.1 Physical Setting

3.1.1 Physiography and Geography

The Project area lies within the central part of the Late Devonian to Early Permian Maritimes Basin, along the southeastern margin of the Indian Mountain Deformed Zone that is sandwiched between the Moncton and Cocagne subbasins to the southeast and northwest, respectively (St. Peter and Johnson 2009). These subbasins are two of several, mostly Late Devonian to Early Carboniferous subbasins in the region that are defined by partly structurally controlled depositional centres filled with a variety of mainly terrestrial groups of clastic sedimentary rock units (e.g., the Tournasian-aged Horton and Sussex groups) mostly ultimately derived from surrounding Late Neoproterozoic to Cambrian basement uplifts.

3.1.2 Topography and Drainage

The topography of the Project site rises to over 62 m above mean sea level (m amsl) in the northern portion of the Project site, and slopes downward towards the central portion of the property (approximately 52 m amsl), and rising again to the south towards Route 890 (approximately 80 m amsl). Drainage from the site is anticipated to flow to the east, towards the North River.

3.1.3 Surficial Geology

The surficial geology of the PDA consists of the Horton/Cumberland Till, a brownish-red till consisting of >80% sedimentary clasts originating from the Horton and Cumberland groups (Pronk et al. 2005). Surficial materials in the Project area generally consists of overburden thickness ranging from 0 to 11 m based on the exploration work. Shallower to virtually no overburden is present over much of the deformed sulphates to the southeast of the melange unit, while generally thicker cover mostly comprising unconsolidated but compact red mud, sandy mud and silt to the northwest over the massive sulphates. Karsting is extremely well developed over the southeastern unit and apparently much less so the northwest.

3.1.4 Bedrock Geology

The bedrock geology of the area is made up of the Carboniferous Windsor Group trending in a northeast-southwest direction. The Windsor Group consists of the Macumber and Upperton formations; the Macumber Formation is mostly grey to tan and pink wackestone and packstone while the Upperton Formation is primarily gypsum and anhydrite (St. Peter 2006). Pre-Windsor Group rocks of the Gautreau and Weldon formations are present to the northwest, consisting of mudstones, shale, sandstones, conglomerate, and limestone (St. Peter 2006). To the southeast, post-Windsor Group rocks consists of the Mabou Group and Salisbury Formation, predominately sandstones and mudstones.

From a recharge to groundwater perspective, the PDA has topographic highs at the northern and southern end of the properties and a topographic low in the central portion. Precipitation accumulates in the tributaries in the central portion of the PDA and drains to the southeast into the North River. Water for domestic purposes in the area is supplied by private wells.

3.2 Biophysical Setting

3.2.1 Climate

New Brunswick has a humid continental climate, with slightly milder winters on the Gulf of St. Lawrence coastline. Northern New Brunswick experiences a subarctic climate, particularly in the more elevated area in the far north. Southern New Brunswick experiences a more moderate maritime climate than the northern or central parts of the province as the Bay of Fundy never fully freezes, thus moderating the winter temperatures and providing generally cooler summer temperatures compared to other inland locations. The cold Bay of Fundy air combining with the inland warmer temperatures often creates onshore winds and periods of fog.

The nearest representative weather station to the Station is located at the Turtle Creek reservoir (approximately 26 km to the east). On average, temperatures are lowest in the winter and early spring, and highest during the summer months. Daily averages range from a low of -8.6°C in January to a high of 19.0°C in July. Precipitation, on average, is highest during the spring (March to May). From 1981 to 2010, the region has received an average of 1,094.2 mm of precipitation per year, of which 823.3 mm was rain and 270.9 cm was snowfall (as water equivalent) (GOC 2022a).

3.2.2 Atmospheric Environment

Southern New Brunswick may experience some short-term challenges with ambient air quality due to its location downwind of large urban centres in eastern North America (as a result of long-range transport of air contaminants), and the presence of several large emission sources (particularly from heavy industry) in the southern part of the province. Despite this, air quality in the region has improved considerably in the past decades and continues to improve. Based on the data from NAPS (2022), in general, air quality in Moncton, which is the closest representative station (approximately 39 km to the northeast of Glenvale) can be characterized as good to very good, most of the time, with occasional short-term periods of poor air quality (particularly in summer). By extension, ambient air quality in more rural areas of Southern New Brunswick (such as the Glenvale area) can be inferred to be equivalent to, or better than that in Moncton, particularly in view of the rural character of the Glenvale area with few emission sources nearby.

The Project is located in a rural, mostly forested area with limited residential dwellings nearby in the community of Glenvale, Westmorland County. Some industrial sources, which tend to release air contaminants, are located nearby in the city of Moncton. Sources of air contaminants in the immediate vicinity are mainly limited to vehicle and home heating emissions. The low population density and rural character of the area, and the lack of substantive emission sources in the area, likely contribute to favourable ambient air quality.

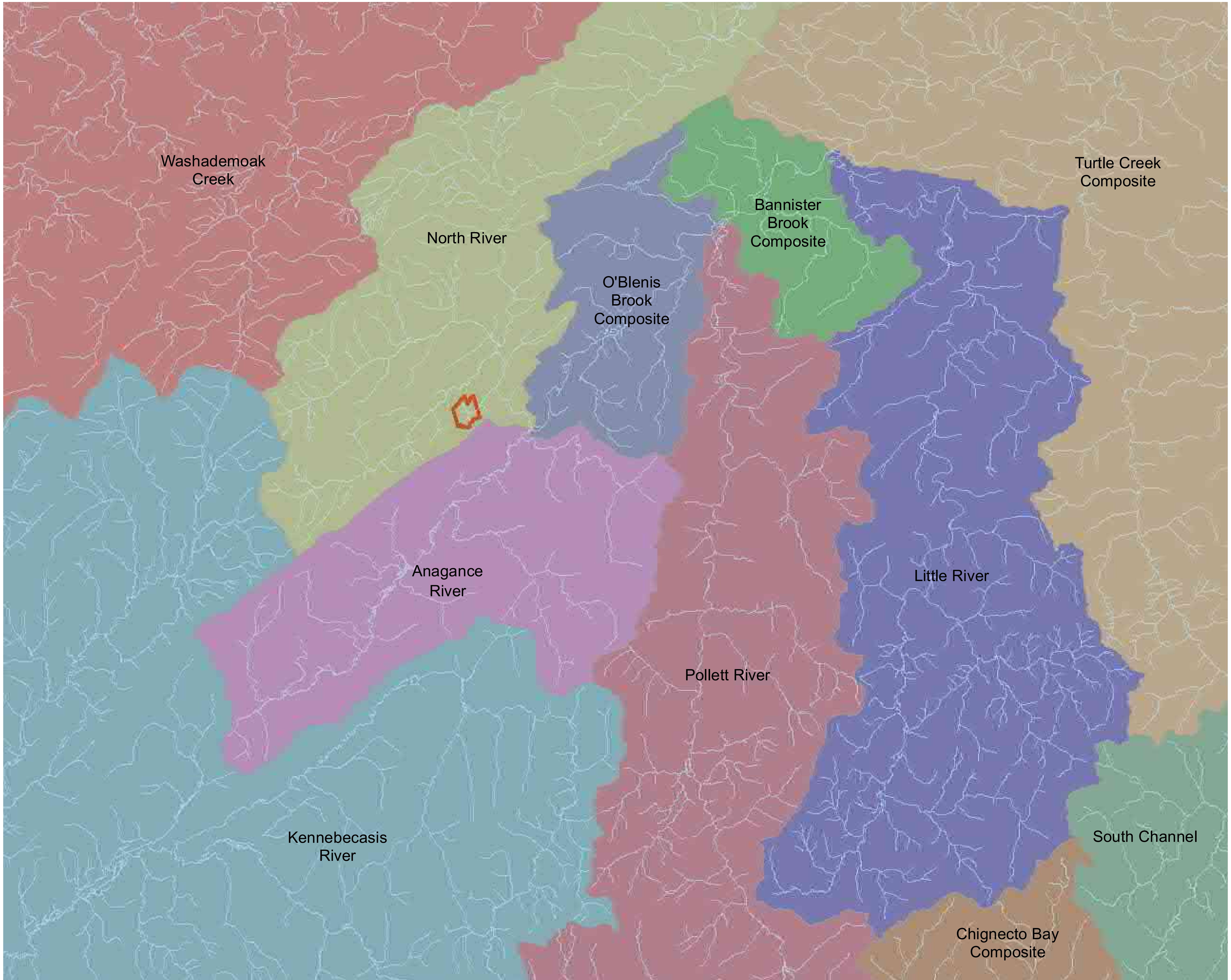
Sound quality in the area of the Project can be characterized as typical of a rural, sparsely populated area of New Brunswick, and mainly influenced by human activities and road traffic.

3.2.3 Freshwater Environment

The Project is located in southern New Brunswick, approximately 4 km west of the village of Petitcodiac and lies within the Petitcodiac River watershed. The Petitcodiac River ultimately discharges into the Shepody Bay which, in turns, flows into the eastern portion of the Bay of Fundy. The Petitcodiac River has a total drainage area of approximately 2,831 km^2 (NBDELG 2007). The North River originates in Indian Mountain and runs in a southwesterly direction for a distance of approximately 34 km (straight-line distance) until it meets the Anagance River, combining to become the Petitcodiac River in the village of Petitcodiac. The Petitcodiac River flows northeast for approximately 40 km to the city of Moncton and then south for approximately 30 km into Shepody Bay. **Figure 3.2.1** depicts the Petitcodiac watershed and major subbasins in relation to the PDA. Information regarding the Terrestrial Environment (ecoregions), discussed in **Section 3.2.4**, is depicted on **Figure 3.2.2**.

The mapped watercourses (as mapped on the GeoNB website) that intersect with the PDA include the reaches of three small unnamed tributaries to the North River, with one being associated with a wetland feature on the Project site. Refer to **Figure 5.3.1** in **Section 5.3** for a depiction of the water resources encountered in the PDA.

There are at least 14 fish species in the Petitcodiac River watershed. These include: American eel, American shad, Atlantic salmon, Atlantic tomcod, blueback herring, alewife, brook trout, brown bullhead, chain pickerel, rainbow smelt, smallmouth bass, striped bass, white perch, and white sucker (NBDELG 2007), among possible others. Due to their connection with the Petitcodiac River, the unnamed tributaries in the PDA have the potential to support these fish species as well.



HAMMOND RIVER HOLDINGS LIMITED
PROPOSED GLENVALE GYPSUM QUARRY

WATERSHEDS IN RELATION TO PDA
FIGURE 3.2.1

Watercourse
Project Development Area

0 1 2 4 Kilometers
SCALE 1:150,000
N W E S

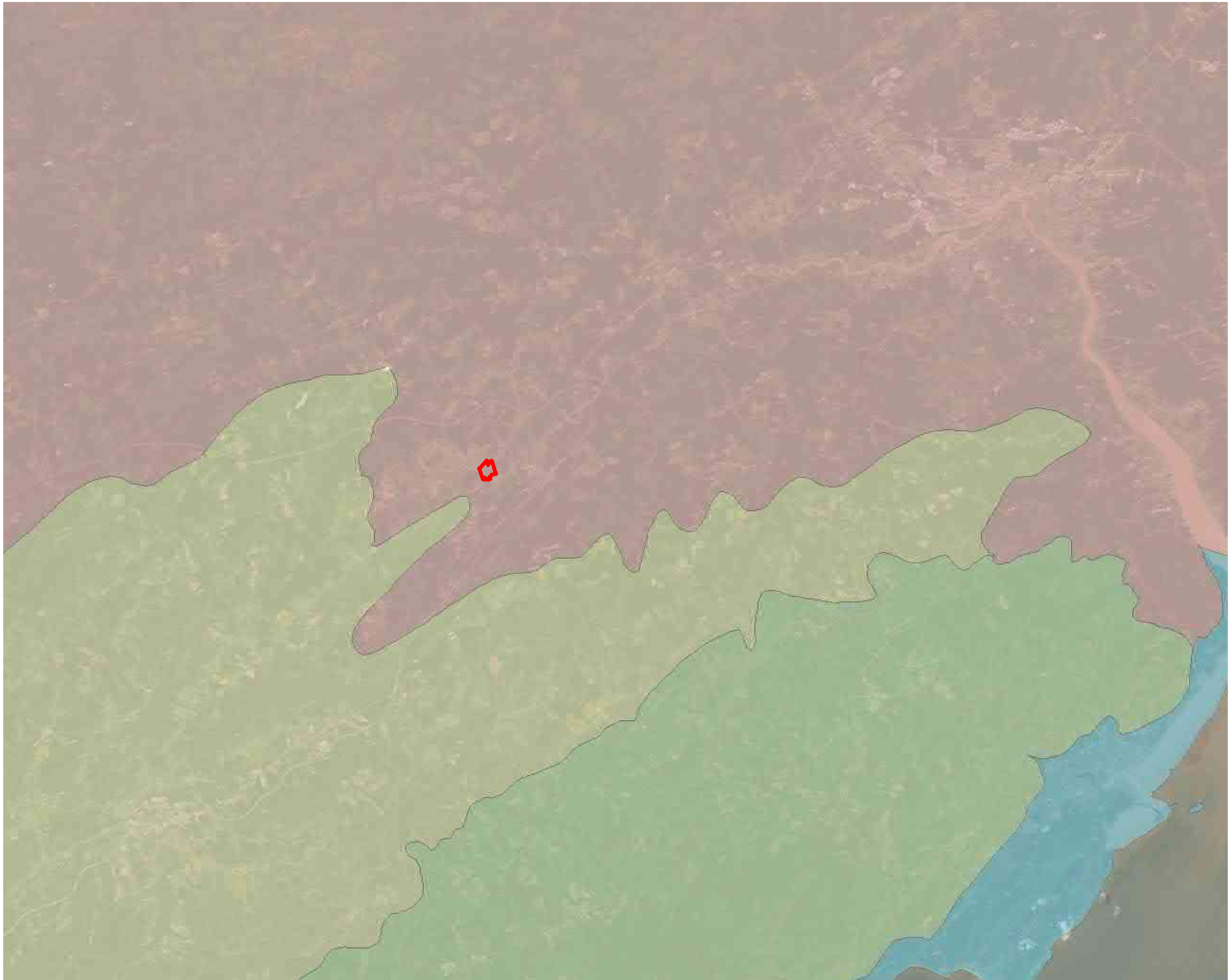
MAP DRAWING INFORMATION:
DATA PROVIDED BY DILLON CONSULTING LIMITED, CANVEC
SERVICE LAYER CREDITS: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), SWISS TOPO, OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

MAP CREATED BY: RP
MAP CHECKED BY: JO
MAP PROJECTION: NAD_1983_CSRS_NEW_BRUNSWICK_STEREOGRAPHIC

DILLON CONSULTING

PROJECT: 22-4280
STATUS: FINAL
DATE: 2022-09-21

FILE LOCATION: K:\2022\224280\Product\Client\Glenvale\Figure 3.2.1 Watershed Relation to PDA.mxd



HAMMOND RIVER HOLDINGS LIMITED
PROPOSED GLENVALE GYPSUM QUARRY

ECOREGIONS IN RELATION TO THE PDA
FIGURE 3.2.2

- Site Location
- Central Uplands Ecoregion
- Eastern Lowlands Ecoregion
- Fundy Coastal Ecoregion
- Valley Lowlands Ecoregion

0 1.5 3 6 Kilometers
SCALE 1:250,000

MAP DRAWING INFORMATION:
DATA PROVIDED BY DILLON CONSULTING LIMITED, CANVEC
SERVICE LAYER CREDITS: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), SWISS TOPO, OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

MAP CREATED BY: RP
MAP CHECKED BY: JO
MAP PROJECTION: NAD_1983_CSRS_NEW_BRUNSWICK_STEREOGRAPHIC

DILLON CONSULTING

PROJECT: 22-4280
STATUS: FINAL
DATE: 2022-09-21

FILE LOCATION: K:\2022\224280\Product\Client\Glenvale\Figure 3.1.1 Site Location in Relation to Ecoregions.mxd

3.2.4 Terrestrial Environment

The Project is located within the Eastern Lowlands ecoregion and, more specifically, within the Petitcodiac ecodistrict (see **Figure 3.2.2**). The Petitcodiac River dominates the landscape. It begins in the boggy plateau of the Castaway Ecodistrict and flows southwest to the village of Petitcodiac. There, it turns abruptly northeast to parallel the regional bedrock structure until reaching Moncton, where it angles again to pour southward into a river estuary and Shepody Bay (Zelazny 2007).

Red spruce dominates the forest, together with white spruce, black spruce, balsam fir, red maple, white birch, and trembling aspen. Other species such as tamarack, white pine, and hemlock, may be present. Tolerant hardwood stands of sugar maple, beech, and yellow birch are found on ridgetops or upper slopes, especially over slightly calcareous soils (Zelazny 2007).

3.3 Socioeconomic Setting

3.3.1 Demographic Overview

According to the Statistics Canada 2021 Census Profile for Salisbury Parish Census Subdivision (the smallest census division available for the Project location), the total population in 2021 was 3,377, down 0.3% from 3,388 in 2016. The population density of the parish is 3.9 persons per square kilometre, compared to 10.9 for the province. The age distribution of people living in Salisbury Parish for the 2021 Census indicates that the largest proportion of the population is in the 55-64 age group, followed by the 45-54 age group. The number of dwellings occupied by usual residents in Salisbury Parish is 1,353, while the total number of private dwellings is 1,432 (Statistics Canada 2022a).

3.3.2 Economic Activity

The Project is located in the Southeast Economic Region which includes Albert, Westmorland, and Kent Counties. The City of Moncton is the economic centre of the region and holds the largest population in the Southeast Region. The Glenvale area itself is a sparsely populated rural area of southeastern New Brunswick, with agriculture and forestry as the primary economic activities of the local area.

Compared to the rest of the Province of New Brunswick, Salisbury Parish is specialized in natural resources trades, transport, and equipment related occupations. Salisbury Parish has a significantly higher percentage of workers in the trades, transport, and equipment related occupations compared to the remainder of the province.

3.3.3 Land Use

The Project is located in the small community of Glenvale, Salisbury Parish, Westmorland County, in Southeastern New Brunswick. Like other communities in the area, Glenvale is a sparsely populated rural community with land use generally focused on residential, forestry, and agricultural uses.

The PDA is located within the Regional Service Commission (RSC) 7, which is comprised of 24 local service districts (LSDs), the villages of Memramcook, Petitcodiac, Port Elgin and Riverside-Albert, and the towns of Shediac and Riverview. The Project site is located within the LSD of Salisbury. Development in Salisbury Parish is guided by the Westmorland-Albert Rural Plan (Southeast Regional Service Commission 2022). As of January 1, 2023, Glenvale will be part of The Community of Three Rivers. New land-use permits will have to be approved by the council for the community, consisting of 1 mayor, 4 councillors, and 3 wards.

Residential land use in the vicinity of the PDA is a linear pattern along the main roads, primarily Route 890 and Baseline Road. Approximately 40 residential dwellings are located within a 1 km radius of the Project site. Other land uses within the general vicinity are limited to the arena and school in Petitcodiac as well as a golf course northeast of the Project site.

3.3.4 Infrastructure and Services

The Glenvale area is a sparsely populated rural area of southeastern New Brunswick, and few infrastructure and services are located nearby. The Petitcodiac Volunteer Firefighter Hall is located at 63 Main Street in Petitcodiac, approximately 3 km from the Project site.

Policing services in the area are provided by the Royal Canadian Mounted Police (RCMP), with the nearest detachments located in Moncton and Sussex. Emergency medical services are provided by Ambulance New Brunswick with stations also in Sussex, and Moncton. Health Services are provided by the Horizon Health Network and the Vitalité Health Network, with the nearest hospitals located in Moncton.

Highway 7 and Highway 1 are the primary transportation routes through Salisbury Parish; these two major highways run north and south of the PDA, respectively. Highway 1 crosses southern New Brunswick from St. Stephen to Petitcodiac, connecting Saint John and Moncton. Highway 7 is part of the TransCanada Highway which bisects the province from northwest to southeast (near Edmundston and Sackville, respectively) and connects the two cities of Fredericton and Moncton. Secondary routes include Route 890 which connects Petitcodiac and Sussex southwest of the PDA, and Route 885 connecting Petitcodiac to the community of Havelock further north.

The Canadian National (CN) Rail line between Moncton and Saint John runs through Salisbury Parish, approximately 3 kilometers southeast of the PDA. There is a small hangar and airstrip in Havelock, approximately 9 km northwest of the Project. The nearest major airport is the Greater Moncton Roméo LeBlanc International Airport, approximately 45 km northeast of the Project.

4.0 Environmental Assessment Scope and Methods

The scope of the environmental impact assessment (EIA) of the Project under the New Brunswick *Environmental Impact Assessment Regulation – Clean Environment Act* (EIA Regulation) is discussed within the following sections.

4.1 Scope of the Assessment

As noted in **Section 1.3.1.1**, the proposed Project must be registered under the New Brunswick EIA Regulation. This registration document is intended to fulfill the requirements for registration of the Project under the provincial regulation, to initiate the EIA review of the Project. However, as described in **Section 1.3.2**, there are no known requirements for a federal impact assessment under the *Impact Assessment Act,* since the Project is not located on federal land and gypsum extraction is not a designated project as defined in the *Physical Activities Regulations* under that Act.

The Project includes the development of an open pit, on-site processing operations, and transportation route for the extraction and transportation of gypsum mineral for use in the manufacturing of wallboard. Refer to **Section 2.3** (Description of Project Components) and **Section 2.4** (Description of Project Phases and Activities) for specific details of the Project. The scope of the Project to be assessed under the EIA Regulation includes construction of the open pit and related facilities and infrastructure, operation of the open pit quarry and related facilities, and eventual reclamation and closure of the site at the end of Project life. The scope of Project to be assessed is limited to the facilities and activities that will be conducted on the Project site, up to and including the time that trucks arrive at and leave the Project site, but excludes the transportation of materials on the provincial highway network as well as activities that are carried out by third parties (e.g., the manufacture of gypsum wallboard).

The related Project phases, and activities to be conducted within each phase, that are subject to this EIA Registration and that will be carried forward within this assessment, were defined in **Section 2.4** and are summarized in **Table 4.1.1**, below.

Table 4.1.1: Project Phases and Activities to be Carried Forward within the EIA

Project Phase	Activities to be Conducted
Construction	• Vegetation clearing • Grubbing • Grading, levelling and contouring • Construction of storage areas • Removal and stockpiling of topsoil and overburden • Construction of perimeter channels, drainage channels, sump, and settling pond • Development of internal site roads and paving of access road • Installation of optional truck scale, optional portable trailer/office, and security gate
Operation	• Open pit operation (drilling, blasting, excavation, hauling, crushing) • On-site transportation, storage, loading, and transportation to customers • Surface water management
Reclamation and closure	• Decommissioning • Reclamation • Closure

The scope of this EIA Registration has been developed by Hammond River Holdings and Dillon, and is based upon the current understanding of the nature of the Project and the environmental setting within which it will be carried out, the proposed Project phases/activities listed above, the professional judgment of the Study Team, as well as consultation with the regulatory authorities (including the technical review committee), engagement with local First Nations, and anticipated issues and concerns of the public as informed by experience with similar projects conducted elsewhere.

4.1.1 Selection of Valued Components

Valued components (VCs) are those components of the biophysical and socio-economic environments that are of value or interest to regulatory agencies, the public, other stakeholders, and/or Indigenous peoples. VCs are typically selected for assessment on the basis of: regulatory issues, legislation, guidelines, policies, and requirements; consultation with regulatory agencies, the public, stakeholder groups, and Indigenous communities; field reconnaissance; and professional judgment.

The VCs selected for this EIA Registration and the rationale for their selection in relation to the Project are outlined in **Table 4.1.2**, below.

Table 4.1.2: Valued Components for the Project, and Rationale for their Selection

Valued Component (VC)	Rationale for Selection of the VC
Atmospheric environment	• Emissions of particulate matter (particularly dust), combustion gases, and sound related to Project activities may affect the atmospheric environment or adjacent receptors.
Water resources (surface water and groundwater)	• The Project will result in a change in surface water drainage and groundwater seepage as a result of site development and the presence of the open pit.
Fish and fish habitat	• Fish and fish habitat are protected by the federal *Fisheries Act*. The Project may interact with fish and fish habitat through the loss of some segments of watercourses and/or wetlands located on the Project site.
Vegetation and wetlands	• The Project will result in the loss of immature vegetation and wetlands located on the Project site, with potential associated loss of biological functions. Indirect loss of wetlands located on adjacent properties is also possible due to potential drainage into the open pit.
Wildlife and wildlife habitat	• The loss of immature vegetation on the Project site may result in the loss of wildlife habitat, and Project activities may interact with wildlife (e.g., sensory disturbance due to Project activities).
Agricultural land and livestock	• The Project may interact with surrounding agricultural land and livestock from emissions, noise, and vibration.
Socioeconomic environment	• The Project will interact with labour and economy through the generation of employment and associated expenditures. • The Project will result in a change in land use from forestry to mineral extraction activity for the duration of the Project. • The Project will result in increased trucking on provincial roads leading to the Project site.
Heritage resources	• Heritage resources (e.g., archaeological, palaeontological, or built heritage resources) are protected under the New Brunswick *Heritage Conservation Act.* • Though there are no known heritage resources that will be affected by the Project, earth moving activities on the Project site may result in the potential accidental discovery of previously unknown heritage resources that may be present on the Project site.
Traditional land and resource use	• The Project is located in the traditional territory of the Wolastoqiyik Nation, the Mi'kmaq Nation, and the area is subject to a land claim by the Elsipogtog First Nation. It is possible that the Project site has historically been, or may be currently used by, Indigenous persons for practicing traditional activities such as hunting, fishing, trapping, and gathering through the practice of affirmed Indigenous and treaty rights. Engagement with all sixteen Indigenous communities in New Brunswick will occur to determine the extent of potential traditional land and resource use of the site and surrounding area by Indigenous people
Effects of the environment on the Project	• Natural forces and other effects of the environment (such as climate change and other natural hazards or risks) may pose a risk to the Project components and their longevity, or cause delays in the construction or operation of the Project.

The following sections provide a description of the methods of desktop and/or field studies that were required to assess the VCs detailed in **Table 4.1.2**, based on professional judgment, the nature of the Project, knowledge of the Project area, and previous experience on projects of a similar nature. In addition, the methods employed for the analysis of environmental effects are discussed.

4.2 Environmental Assessment Methods

Environmental assessment is used as a planning tool in the initial stages of project conceptualization, planning and design. Its intention is to identify or predict Project-related effects (based on results of scientific assessment or traditional knowledge), as well as design mitigative strategies to avoid, reduce, or eliminate adverse environmental effects. The methods used to conduct the environmental effects assessment for the Project, including the characterization of the study boundaries, the factors to be considered, and the details of the assessment of each VC selected in **Section 4.1.1**, are provided below.

4.2.1 Study Boundaries (Temporal and Spatial)

Study boundaries set the limits of the area (spatial) and period of time (temporal) examined within the assessment. Boundaries for the EIA were defined by good practice and professional judgment.

Temporal boundaries vary according to the different Project phases and potential effects. In the construction phase, specific construction-related effects are typically short-term (for example, effects related to the use of laydown areas for construction activities). Effects associated with the operation phase tend to be longer term (i.e., lifespan of the quarry); however, some effects associated with the open pit are unique in the sense that they will be long lasting and will extend past the life of the quarry. The temporal boundaries for the Project correspond to the periods of construction, operation, and reclamation and closure as were defined in the Project schedule in **Section 2.5.**

The spatial boundaries of the assessment, which represent the area in which a potential effect could occur and will vary by VC, will typically be based on natural system boundaries for biophysical VCs, or administrative/political boundaries for socio-economic VCs. The spatial boundaries to be defined for the EIA will include:

- The **Project development area (PDA)**, where physical alterations occur to enable the Project to be carried out (common for all VCs), as defined in **Section 2.1**. It can be thought of as the area of physical disturbance associated with the Project facilities; and,
- The **local assessment area (LAA**), where the potential direct and indirect interactions of the Project may occur with each VC (defined for each VC). It can be thought of as the "zone of influence" of the Project.

4.2.2 Factors to be Considered

The EIA will consider the following factors:

- the environmental effects of the physical activities associated with the Project;

- mitigation measures that are technically and economically feasible and that would mitigate significant adverse environmental effects of the Project, including requirements for follow-up studies or monitoring;
- the environmental effects of malfunctions or accidents that may occur in connection with the Project;
- any change to the Project that may be caused by the environment;
- guidance provided by Indigenous communities; and,
- comments from the public or other stakeholders.

4.2.3 Scope of Factors to be Considered

The VCs selected for this EIA will be assessed at an appropriate level based on professional judgement, existing information, regulatory issues, legislation, guidelines, policies, requirements and engagement. In order to characterize the baseline conditions of each VC, both qualitative and quantitative assessment methods were employed. The characterization and description of the VC is limited to the spatial and temporal boundaries (as described in **Section 4.2.1**) that were applied to that specific VC for the purposes of the assessment. The factors to be considered during the assessment as well as the approach that will be used to carry out the assessment are further discussed in **Table 4.2.1**, below.

Table 4.2.1: Scope of Factors to be Considered and Approach to the Assessment for each Valued Component

Valued Component (VC)	Scope of Factors to be Considered	Approach to the Assessment
Atmospheric environment	• Air contaminant emissions • Ambient air quality • Sound quality (noise) • Greenhouse gas (GHG) emissions	• Quantitative and qualitative assessment of ambient air quality and trends • Quantitative assessment and emissions estimation of air contaminant emissions and GHG emissions • Baseline noise monitoring, and noise modelling
Water resources (surface water and groundwater)	• Physiography and surface water drainage • Bedrock and surficial geology • Hydrogeology • Groundwater resource use within 2 km of the Project • Groundwater and surface water quality and quantity	• Quantitative and qualitative desktop assessment of regional groundwater environment • Quantitative assessment/ reconnaissance of surface water features and hydrogeological assessment
Fish and fish habitat	• Fish and fish habitat • Species at risk and their habitat • Species of conservation concern and their habitat	• Review of historical occurrences of species at risk/species of conservation concern

Valued Component (VC)	Scope of Factors to be Considered	Approach to the Assessment
	• Fisheries including sport or subsistence fisheries • Fish migration routes/movement corridors • Surface water quality	• Biological field studies of fish and fish habitat
Vegetation and wetlands	• Vegetation including rare plants • Species at risk and their habitat • Species of conservation concern and their habitat • Wetland delineation and function	• Review of historical occurrences of species at risk/species of conservation concern • Field wetland delineation and functional assessment • Rare plant survey and recording of vegetation species
Wildlife and wildlife habitat	• Wildlife and wildlife habitat • Species at risk and their habitat • Species of conservation concern and their habitat	• Review of historical occurrences of species at risk/species of conservation concern • Biological field studies of avian wildlife, combined with incidental wildlife observations
Agricultural land and livestock	• Agricultural land • Livestock	• Qualitative assessment of effects on agricultural land and livestock
Socioeconomic environment	• Nuisance effects to adjacent receptors (noise, dust, viewscape, vibration) • Change in land use • Road transportation network • Local economy and Project-related employment	• Public and stakeholder engagement • Qualitative assessment of local socioeconomic environment • Results of baseline noise monitoring and modelling • Understanding of local planning requirements
Heritage resources	• Structures, sites or things of historical, archaeological, palaeontological, or architectural significance	• Qualitative (desktop and database review of high potential areas) • Initial walkover • Provision for later field investigation (shovel testing) as follow-up
Traditional land and resource use	• Biophysical resources of cultural importance • Current use of land and resources for traditional purposes by Indigenous persons	• Indigenous engagement • Information from secondary sources
Effects of the environment on the Project	Changes or potential effects on the Project caused by: • Extreme weather • Climate change • Natural forest fires	• Qualitative assessment of current regional/local climate conditions and predictions

4.2.4 Environmental Effects Assessment Methods

Dillon uses a streamlined and focussed approach in the preparation of the effects analysis. During the environmental effects analysis, Project-VC interactions are first identified through a matrix table. If a Project-VC interaction is not identified, a rationale is provided to explain its exclusion from the assessment.

Following the identification of Project-VC interactions, effects that may occur as a result of the interactions are predicted and proposed mitigation is outlined. Effects are assessed assuming that standard industry design/mitigation practices will be implemented. The environmental effects assessment methodology involves the following generalized steps.

- **Scope of VC** – This involves the scoping of the assessment for the VC, and includes a definition of the VC and a rationale for its selection, a description of temporal and spatial boundaries, and the definition of thresholds that are used to determine the significance of environmental effects. This step relies upon the scoping undertaken by regulatory authorities; consideration of the input of the public, stakeholders, and First Nations (as applicable); and the professional judgment of the Study Team.
- **Existing Conditions** – This step involves the establishment of existing (baseline) environmental conditions for the VC, in the absence of the Project. In many cases, existing conditions expressly and/or implicitly include those environmental effects that may be or may have been caused by other past or present projects or activities that have been or are being carried out.
- **Environmental Effects Assessment** – Project-related environmental effects are assessed. The assessment includes:
  - a description of how a potential environmental effect could occur (in the absence of mitigation);
  - a discussion of the mitigation and environmental protection measures that are proposed to avoid, reduce, or eliminate the environmental effect; and,
  - a characterization of the residual environmental effects of the Project (i.e., the environmental effects that remain after planned mitigation has been applied). Each phase of the Project is assessed (i.e., construction, operation, and reclamation and closure), as are accidents, malfunctions, and unplanned events. The evaluation also considers the effects of the environment on the Project.
- **Summary** – A summary of the assessment for the VC is provided, leading to an overall conclusion in respect of the effects of the Project on the VC. The significance of residual environmental effects is then determined, in consideration of the significance thresholds that have been established for each VC.

The Study Team will consider the direction, magnitude, frequency, duration, geographical extent, and reversibility of potential Project-related effects. Residual effects (i.e., those that remain after the application of mitigation, or those that will not be avoided/mitigated) are predicted, and thresholds of significance are characterized using regulatory standards or other thresholds, where available, within the defined spatial and temporal boundaries. Where regulatory standards are not available, the significance threshold may be determined through indicators derived from existing scientific knowledge (e.g., status of biological populations and critical habitats). Through this process, potential effects on the environment are evaluated with a view to mitigating them such that effects can be avoided, reduced, or controlled through mitigation. A determination is then provided as to whether residual effects are positive or negative, their significance, and the likelihood of a significant effect. Consideration is also given to the potential for accidents or malfunctions during the Project phases (provided in a standalone section).

Follow-up measures and monitoring programs for potential residual environmental effects are outlined and described, where applicable, for planned implementation as a means of verifying the environmental effects predictions or the effectiveness of mitigation.

5.0 Environmental Effects Assessment

An assessment of the environmental effects of the Project on each of the identified valued components (VCs) is provided in this chapter.

In this chapter, following an identification of Project interactions with the environment, potential environmental effects in the absence of mitigation are described at a high level with a view to determining if an interaction between the Project and the VC could occur. The identification of Project-VC interactions is done for each Project phase in a matrix format (see **Section 5.1**, Project Interactions with the Environment) to determine which potential interactions may occur; justification is provided for those VCs for which the Project is not expected to interact. Then, for each VC for which an interaction with the Project was identified, a more detailed assessment is provided in a standalone section whereby: the scope of the VC is defined; existing conditions are established; potential effects without mitigation are identified; mitigation to avoid, reduce, or eliminate environmental effects are described; and residual environmental effects after the application of mitigation are described.

5.1 Project Interactions with the Environment

The identification of potential interactions between the Project and the VCs has been undertaken in consideration of the nature of the Project and its planned activities during each phase. Additionally, accidents and malfunctions will be considered in **Section 7.0**.

The phases of the Project include:

- Construction;
- Operation; and,
- Reclamation and closure.

This initial screening (i.e., Project interaction matrix) assists in determining if an interaction between the activities being carried out in each phase of the proposed Project and the VC is possible. A qualitative rating system was used to evaluate the potential for interactions between the Project and the environment.

One of the following two ratings was prescribed for each individual VC:

- An interaction between the Project and the environment could occur (which is identified with a checkmark in the matrix below); or,
- No interaction occurs between the Project and the environment (I.e., no checkmark).

Based on the Project Description (refer to **Section 2.0**), the Environmental Setting (refer to **Section 3.0**), and the scope of the environmental assessment (refer to **Section 4.0**), the potential interactions between the Project and the environment are summarized in **Table 5.1.1** below.

Table 5.1.1: Potential Interactions between the Project and the Environment

Valued Component (VC)	Project Phases		
	Construction	Operation	Reclamation and Closure
Atmospheric environment	✓	✓	
Water resources	✓	✓	✓
Fish and fish habitat	✓	✓	
Vegetation and wetlands	✓	✓	✓
Wildlife and wildlife habitat	✓	✓	✓
Agricultural land and livestock	✓	✓	✓
Socioeconomic environment	✓	✓	✓
Heritage resources	✓	✓	
Traditional land and resource use	✓	✓	✓

Legend: ✓ = Potential interaction

In the table above, the interaction with a particular VC is identified when the interaction first occurs.

VCs for which an interaction occurs are carried forward in the environmental effects assessment in **Sections 5.2** to **5.9**, below. Some VCs were found to not have interactions during a Project activity. A brief justification/rationale behind the selection or omission of an interaction is provided below (this is also related to the selection of VCs for the assessment which can be referenced in **Section 4.1.1**).

5.1.1 Atmospheric Environment

Emissions of particulate matter (particularly dust), combustion gas, and sound related to project activities may occur during construction activities (site development) and operation (resource extraction and processing) and affect the atmospheric environment or adjacent receptors. Substantive interactions during reclamation and closure are not expected.

5.1.2 Water Resources

The Project will result in a change in both surface water and groundwater flow across the landscape as a result of the loss of on-site watercourses (construction activities) and the development of the open pit (construction and operation activities). Upon reaching the end of the lifespan of the quarry, water will require further management for site reclamation and closure as the open pit will act as a reservoir for surrounding drainage.

5.1.3 Fish and Fish Habitat

The Project will interact with fish and fish habitat through the loss of watercourses during the construction activities. Additionally, an interaction will occur during operation as there may be water drainage into the natural environment from a settling pond on-site. Substantive interactions during reclamation and closure are not expected.

5.1.4 Vegetation and Wetlands

During construction, the Project will require the loss of vegetation and the regulated wetland will likely be indirectly affected by the diversion of surface water flow. This will result in the loss of biological functions. During operation, water drainage into the natural environment will occur from a settling pond on-site, and may interact with the adjacent wetland. Upon reclamation and closure, vegetation will be able to naturally regenerate over time, and the affected wetland may be naturally restored. Additionally, wetland creation/enhancement around the open pit may occur as a part of a habitat compensation plan or site reclamation plan for water management.

5.1.5 Wildlife and Wildlife Habitat

During construction, the Project will result in the loss of wildlife habitat (from clearing activities). During operation, Project activities may interact with wildlife through noise, vibration, or increased traffic in the area. Following site reclamation and closure, wildlife will be able to return to the site and some wildlife habitat will be restored through revegetation, providing a positive effect.

5.1.6 Agriculture and Livestock

During construction, the Project may interact with agricultural lands and livestock through noise, vibration, and emissions from the Project. The Project will also result in the loss of potential food sources (vegetation) for bees from nearby bee farms. The Project may also affect agricultural lands and livestock through potential changes to water resources which may be used for irrigation. Noise, vibration, and emissions from the Project may also interact with agricultural lands and livestock during the operation and reclamation and closure phases of the Project.

5.1.7 Socioeconomic Environment

During construction, the Project may interact with the socioeconomic environment through noise, vibration, and emissions from the Project, as well as from a change in land use as the character of the site changes from forestry/agriculture to industrial activity. During operation, potential nuisance effects from noise, vibration, and emissions could be experienced in a manner similar to those experienced during construction. Additionally, the Project will interact with labour and economy through employment and expenditures during both construction and operation phases. Upon site reclamation and closure, the Project will cease to interact with the socioeconomic environment through employment and expenditures. Once reclaimed, though not encouraged, the local population could access the site for recreational purposes.

5.1.8 Heritage Resources

During the construction phase of the Project, there is potential for accidental discovery of archaeological or heritage resources—the effect would be permanent in such a case, as no archaeological or heritage resource can be returned to the ground undisturbed following its discovery. During operation, though the discovery of archaeological resources would not be expected (as those resources are typically located in surficial soils rather than bedrock), there is a potential for accidental discovery of palaeontological resources (fossils) during the operation phase (i.e., during extraction of gypsum). Substantive interactions during reclamation and closure are not expected.

5.1.9 Traditional Land and Resource Use

During the construction phase, Indigenous peoples that may have used or are using the Project site to carry out their traditional activities will no longer be able to access the entirety of the PDA for safety and security purposes while Project activities are taking place, and therefore this area will no longer be accessible for potential traditional land and resource use. This interaction will extend through the lifespan of the Project, until the end of the operation phase. Upon site reclamation and closure, the PDA will become re-accessible for traditional land and resource use.

The following sections are organized by VC, and describe: the scope of each VC; their existing conditions (based on the qualitative and quantitative assessments described herein); potential environmental effects that could occur in the absence of mitigation; planned mitigation to offset, reduce or eliminate predicted effects; and residual effects that may occur after the implementation of site specific and general mitigation. Furthermore, and where applicable, specific follow-up or monitoring plans to verify the effects predictions or the effectiveness of mitigation will be described.

5.2 Atmospheric Environment

The potential environmental effects of the Project on the atmospheric environment are assessed in this section.

5.2.1 Scope of VC

The atmospheric environment is defined as the layer of air above the earth's surface to a height of approximately 10 km. The atmospheric environment includes three (3) key aspects: air quality, climate (including greenhouse gases), and sound quality, as follows.

- Air quality is characterized by the composition of the ambient air, including the presence and quantity of air contaminants in the atmosphere in comparison to applicable air quality objectives.
- Climate is characterized by the historical seasonal weather conditions of a region, which can include temperature, humidity, precipitation, sunshine, cloudiness, and winds. Statistical climate data are typically averaged over a period of several decades (GOC 2022a). Project-based releases

of greenhouse gases (GHGs), such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), are typically used as an indicator of the potential for environmental interactions with climate change. It is understood that GHG releases on a global scale from both natural processes/sources and human activities are increasing global concentrations of GHGs in the atmosphere and they contribute to climate change.

- Sound quality is characterized by the type, frequency, intensity, and duration of noise (unwanted sound) in the outdoor environment. Vibration, or oscillation in matter that may lead to noise or stress in materials of adjacent structures, is also considered as an element of sound quality.

The atmospheric environment has been selected as a valued component (VC) because the atmosphere helps maintain the health and well-being of humans, wildlife, vegetation, and other biota. Emissions from the Project to the air may cause adverse environmental effects through the various transport, dispersion, deposition, and transformation processes that occur in the atmosphere. GHG emissions are thought to be a major factor in affecting global climate.

The atmospheric environment includes consideration of potential environmental effects on air quality, including GHG emissions. These components constitute a VC due to:

- Emissions of contaminants to the atmosphere during construction and operation of the Project, which may present a pathway for humans and biota to be exposed to air contaminants;
- Provisions regarding air contaminant emissions and noise under the New Brunswick *Air Quality Regulation*;
- Releases of GHGs and their accumulation in the atmosphere influence global climate and may affect emission reduction targets for GHGs that have been set or are being developed federally and provincially; and/or,
- Emissions of sound pressure (including vibration) to the atmosphere during construction and operation of the Project may present a disturbance or nuisance for humans and wildlife nearby.

This assessment of the atmospheric environment considers the air contaminants that are typically associated with this type of project, which are regulated provincially (and in some cases federally). These air contaminants are generated from fuel combustion and fugitive dust generated from the movement of mobile equipment and material transfer mechanisms required for construction and operation. For the Project components and activities assessed herein, combustion gases (including but not limited to sulphur dioxide [SO_2], carbon monoxide [CO], and nitrogen oxides [NO_x]), and particulate matter (PM) are considered to be the potential contaminants of concern relating to air quality. Releases of GHGs from the combustion of fossil fuels in mobile equipment are also considered in relation to the potential for interactions with climate change. Sound pressure levels and vibration in the vicinity of the Project are considered relating to sound quality.

Air quality in New Brunswick is regulated pursuant to the New Brunswick *Air Quality Regulation* 97-133 under the *Clean Air Act*. Federally, the main instrument for managing air quality is the *Canadian*

Environmental Protection Act (CEPA) as well as Canada-Wide Standards (CWS) developed by the Canadian Council of Ministers of the Environment (CCME).

New Brunswick's *Air Quality Regulation* specifies maximum permissible ground-level concentrations for five (5) air contaminants, namely total suspended particulate (TSP), carbon monoxide (CO), sulphur dioxide (SO_2), nitrogen dioxide (NO_2), and hydrogen sulphide (H_2S). The criteria in the regulation are based on the National Ambient Air Quality Objectives (NAAQOs), although the two do differ slightly, as presented in **Table 5.2.1**. The Regulation is legally binding in New Brunswick, whereas the NAAQOs are guidelines used as a benchmark to assess the effects of air pollutants.

Table 5.2.1: Ambient Air Quality Standards and Objectives

		New Brunswick *Air Quality Regulation*	National Ambient Air Quality Objectives (NAAQO)	
Air Contaminant	Averaging Period	Maximum Permissible Ground Level Concentration (µg/m³)	Maximum Acceptable Level (µg/m³)	Maximum Desirable Level (µg/m³)
Total suspended particulate (TSP)	24 hour	120	120	--
	Annual	70 (Geometric mean)	70	60
Carbon monoxide (CO)	8 hour	15,000	15,000	6,000
	1 hour	35,000	35,000	15,000
Nitrogen dioxide (NO_2)	1 hour	400	400	--
	24 hour	200	--	--
	Annual	100	100	60
Sulphur dioxide (SO_2)	1 hour	900	900	450
	24 hour	300	300	150
	Annual	60	60	30
Hydrogen sulphide (H_2S)	1 hour	15	--	--
	24 hour	5	--	--

Source: New Brunswick Regulation 97-133; NAPS (2010)

Note: NAAQO uses conditions of 25 °C and 101.3 kPa in converting from µg/m³ to ppm.

Regulations or guidelines related to sound quality have not been established in New Brunswick and may be addressed through the Certificate of Approvals process for industrial facilities under the *Air Quality Regulation*. In the absence of local guidance, the following generally accepted criteria that have been applied in New Brunswick in the past are proposed for the purpose of the assessment:

- 65 A-weighted decibels (dBA) measured as a 1-hour equivalent sound level (Leq) from 06:00 to 22:00 (Daytime); and,
- 55 dBA measured as a 1-hour Leq from 22:00 to 06:00 (Nighttime).

5.2.1.1 Temporal Boundaries

The temporal boundaries for the Project include the following:

- **Construction**: extending for a period of approximately four months, anticipated to begin in the fourth quarter (Fall) of 2023 (subject to the receipt of all approvals and permits required for the Project);
- **Operation**: beginning in approximately the first quarter of 2024, and lasting for approximately 10 years or until the mineral resource has been depleted; and,
- **Reclamation and closure**: to be initiated following the completion of operations at the site, with decommissioning and reclamation of the surface facilities at the site for an anticipated duration of six months following operation.

5.2.1.2 Spatial Boundaries

The Project development area (PDA) is defined as the area of physical disturbance associated with construction and operation of the Project. Specifically, the PDA consists of an area of approximately 85 ha (i.e., conservatively assumed to be the entirety of PIDs 00814160, 70076948, and 70654058) that includes the open pit and all related surface facilities located on the property. The PDA is the area represented by the physical Project footprint.

The local assessment area (LAA) is the maximum anticipated area within which Project-related environmental effects are expected. For the atmospheric environment, the LAA includes an area consisting of a 2 km radius centred on the PDA, and includes the PDA and adjacent areas where Project-related environmental effects could be expected to occur. Beyond this radius, based on experience with similar facilities and professional judgment, emissions of air contaminants and noise from the Project would not likely be distinguishable from background levels.

5.2.1.3 Significance Threshold

A significant adverse residual environmental effect on the atmospheric environment is one where Project-related releases result in:

- a frequent exceedance of the ambient air quality standards defined in Schedule B of the New Brunswick *Air Quality Regulation* under the *Clean Air Act* (as listed in **Table 5.2.1** above); or,
- the sound pressure levels at the nearest noise sensitive receptor to frequently exceed a 1-hour Leq of 65 dBA during the day (06:00-22:00) or 55 dBA during the night (22:00-06:00).

A frequent exceedance is defined as one that occurs more than 1% of the time.

5.2.2 Existing Conditions

The existing conditions for atmospheric environment are defined in terms of climate, ambient air quality, and sound quality.

5.2.2.1 Climate

New Brunswick has a humid continental climate, with slightly milder winters on the Gulf of St. Lawrence coastline. Northern New Brunswick experiences a subarctic climate, particularly in the more elevated area in the far north. Southern New Brunswick experiences a more moderate maritime climate than the northern or central parts of the province as the Bay of Fundy never fully freezes, thus moderating the winter temperatures and providing generally cooler summer temperatures compared to other inland locations. The cold Bay of Fundy air combining with the inland warmer temperatures often creates onshore winds and periods of fog.

Climate Normals from the nearest representative weather station (located at the Turtle Creek surface water reservoir, approximately 26 km northeast) are presented in **Table 5.2.2** below. Data at the Turtle Creek weather station are limited to temperature and precipitation; therefore, climate normals from the Moncton (A) weather station, approximately 46 km northeast, are also presented in **Table 5.2.2** to capture additional parameters.

Table 5.2.2: Climate Normals, Turtle Creek and Moncton (A), New Brunswick (1981-2010)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temperature Normals, Turtle Creek (1981 - 2010)													
Daily Average (°C)	-8.6	-7.3	-2.6	3.9	10.6	15.6	19.0	18.2	13.4	7.7	1.9	-4.4	5.6
Daily Maximum (°C)	-3.4	-1.8	2.6	9.0	16.7	21.7	24.8	24.0	18.9	12.6	5.8	0.0	10.9
Daily Minimum (°C)	-13.8	-12.7	-7.7	-1.1	4.4	9.6	13.1	12.3	7.9	2.8	-2.0	-8.8	0.3
Precipitation Normals, Turtle Creek (1981 - 2010)													
Rainfall (mm)	28.1	29.6	46.4	60.6	92.2	87.6	83.3	76.7	94.4	97.4	76.9	50.1	823.3
Snowfall (cm)	70.0	55.0	59.3	24.0	2.9	0.0	0.0	0.0	0.0	0.4	10.1	49.3	270.9
Precipitation (mm)	98.0	84.7	105.6	84.6	95.0	87.6	83.3	76.7	94.4	97.8	87.0	99.5	1094.2
Wind Normals, Moncton A (1981-2010)													
Speed (km/h)	19.2	18.7	19.2	18.5	16.7	14.9	13.5	13.2	14.6	16.5	17.8	19.1	16.8
Most Frequent Direction	W	W	W	N	SW	SW	SW	SW	SW	SW	W	W	SW
Maximum Hourly Speed (km/h)	80	92	80	89	64	65	56	61	103	80	76	80	Not applicable
Direction of Maximum Hourly Speed	SW	N	SW	N	S	N	N	S	SE	NE	NW	E	Not applicable
Maximum Gust Speed (km/h)	129	135	161	137	121	109	145	89	124	122	126	126	Not applicable

Source: Canadian Climate Normals (GOC 2022b, GOC 2022c)

Greenhouse gas emissions in Canada totaled 672 million tonnes (Mt CO_2e, as CO_2-equivalents) in 2020 (ECCC 2022), as published in Canada's most recent annual report on greenhouse gas emissions. Greenhouse gases from heavy industry represented 11% of total Canadian emissions. Total greenhouse gases for New Brunswick were 12.4 Mt CO_2e in 2020, whereas they were 19.8 Mt CO_2e in 2005 and

16.2 Mt CO_2e in 1990. Since 2005, New Brunswick has seen a 37% decrease in total greenhouse gas emissions.

5.2.2.2 Ambient Air Quality

The air quality can be defined from historical air quality monitoring conducted in the region for the key contaminants of concern.

There is no ambient air quality monitoring station within the immediate vicinity of the Project, nor one regionally that collects data for every parameter. Therefore, for the purpose of this EIA Registration, air quality is characterized using data collected regionally from the NBDELG's ambient air quality monitoring station at Moncton (approximately 38 km northeast of Glenvale) as the closest representative station to the Project area. The Moncton monitoring station measures particulate matter less than 2.5 microns ($PM_{2.5}$), nitrogen dioxide (NO_2), carbon monoxide (CO), and ground-level ozone (O_3).

The maximum measured concentrations from the Moncton air quality monitoring station data for the respective averaging periods of each contaminant during 2019, as reported in the NBDELG's most recent ambient air quality monitoring report titled "2020 Air Quality Monitoring Results" (NBDELG 2022a) and its supplementary data report (NBDELG 2022b), are presented in **Table 5.2.3**. It is noted that since the data presented in these reports is in graphical form (i.e., raw numerical values are not presented in the reports), the values in the **Table 5.2.3** below are interpolated from the graphs and should be considered approximate.

Table 5.2.3: Ambient Monitoring Data – 2020 Maximums – Moncton Air Quality Monitoring Station

Air Contaminant	Averaging Period	Maximum Ground-Level Concentration Recorded in 2020
Particulate matter less than 2.5 microns ($PM_{2.5}$)	24 hour	20 µg/m^3
Nitrogen dioxide (NO_2)	1 hour	75 µg/m^3
Ground-level ozone (O_3)	1 hour	110 µg/m^3
Carbon monoxide (CO)	1 hour	1,145 µg/m^3

Notes: The maximum reported values for each contaminant are below their respective ambient air quality standards and objectives.

NBDELG (2021a) identifies provincial "air zones" which assists the Department in managing air quality in these regions. The Central Air Zone, within which the Project is located, is described as follows:

"The central air zone is the largest of the three provincial air zones, and occupies New Brunswick's middle latitudes. It encompasses five (5) of New Brunswick's major population centers: Moncton, Dieppe, Fredericton, Miramichi, and Edmundston. Although small by international standards, these cities can experience "big city" air quality issues (that is, the combined impact from many small pollution sources in close proximity - vehicles, homes, businesses, etc.)."

In consideration of this information and the data presented in **Table 5.2.3** above, the ambient air quality in the Moncton region is generally good/very good.

5.2.2.3 Sound Quality

The emission of sound waves from natural and manmade sources, their propagation through the atmosphere, and their detection through auditory or other means at a noise sensitive receptor in the ambient environment characterizes sound quality. Sound pressure level in units of A-weighted decibels (dBA) is the typical measure of sound. The A-weighting scale is the most commonly used scale for expressing the perception of audible noise by humans. Since sound propagation and attenuation occurs largely as a function of increasing distance from the source (among other lesser factors such as topography as well shielding by natural and human-made obstructions), the potential interactions of Project-related noise with a human receptor located in the acoustic environment are more related to the distance between the noise source and receptor rather than specific location or setting.

Baseline noise monitoring is planned for the spring of 2023. The results of this monitoring will be detailed and provided in a supplementary report as an addendum to the EIA Registration document.

For the purposes of this assessment, we focus on predicted noise levels at the two closest residential receptors (PID 70645957 located approximately 415 m north from the center of the proposed quarry, and PID 70513502 located approximately 490 m south of the center of the proposed stockpiling area, shown in **Figure 2.3.1**), with the assumption that Project-related interactions with the acoustic environment at other locations would be of similar or lesser magnitude.

The baseline noise levels assumed to be present at or near the Project were estimated using guidance provided by Health Canada (2017), Alberta Energy Regulator (AER 2007), and United States Environmental Protection Agency (USEPA 1974). Based on the population density (Statistics Canada 2022a) and the lack of other potential substantive noise sources near the well sites (most are in forested areas), it was determined that the noise levels within the Project area would be expected to be typical of a quiet rural area, with estimated baseline sound levels of approximately 45 dBA (USEPA 1974; Health Canada 2017).

5.2.3 Environmental Effects Assessment

The environmental effects of the Project on the atmospheric environment are assessed in this section.

5.2.3.1 Potential Effects

Without mitigation, the Project could interact with the atmospheric environment in multiple ways:

- Emissions of combustion gases and fugitive dust from earth moving activities and transport of materials on site during construction could result in air contaminants that could disperse in the atmosphere to off-site receptors;

- Emissions of combustion gases and fugitive dust from quarrying activities including blasting, excavating, crushing, on-site transport, and storage of gypsum on-site during operation could result in air contaminants that could disperse in the atmosphere to off-site receptors;
- Noise emissions from on-site equipment during construction could result in off-site receptors experiencing a change in ambient sound;
- Noise emissions from on-site equipment and blasting activities during operation could result in off-site receptors experiencing a change in ambient sound; and,
- The operation of mobile equipment and on-site trucks during construction and operation could result in emissions of greenhouse gases.

5.2.3.2 Mitigation

The following mitigation measures will be implemented to reduce environmental effects on the atmospheric environment:

- Maintaining a tree buffer between on-site activities and nearby receptors to mitigate the effect of sound and emissions;
- Application of dust suppressants via water truck during dry periods when appropriate;
- Instituting and following a non-idling policy;
- Vehicles and equipment will be maintained in proper working order;
- Hours of operation of the quarry and crusher will be limited to daytime hours; and,
- Blasting will be limited to daytime hours.

5.2.3.3 Characterization of Residual Effects

Construction Phase

Air emissions during the construction phase are expected to be primarily related to the operation of mobile equipment, trucking, and related construction activities. Construction activities have the potential to result in changes in the local air quality, primarily related to fugitive dust and particulate matter from material movement as well as emissions from combustion associated with construction equipment.

The construction phase will consist primarily of material stripping and clearing using excavators, hauling to material stockpiles using articulated rock trucks, grading activities, and material movement for stockpiling. Estimates of emissions associated with the construction phase are summarized in **Table 5.2.4**.

Table 5.2.4: Total Emissions Associated with Construction (Over an Assumed 4 Month Period)

Air Contaminant	Excavating	Trucking	Grading	Stockpiling	TOTAL
TSP (tonnes)	0.414	1.025	1.024	5.551	**8.015**
PM_{10} (tonnes)	0.268	1.025	0.302	1.333	**2.928**
$PM_{2.5}$ (tonnes)	0.156	1.025	0.035	0.743	**1.960**
CO (tonnes)	1.316	9.897	0.035	1.825	**13.073**
NO_X (tonnes)	2.080	15.642	0.055	2.885	**20.662**
SO_2 (tonnes)	0.112	0.840	0.003	0.155	**1.110**
CO_2e (tonnes)	204.169	1,535.800	5.443	283.209	**2,028.620**

Notes: Emission Factors from AP-42, Sections 3.3, 11.9, 11.19, 13.2 and 13.3 (USEPA 2022a).
Emission modeling completed by using the US EPA Motor Vehicle Emissions Simulator (MOVES; USEPA 2022b).

The majority of dust emissions observed during the operation phase are related to fugitive dust from material transfer activities associated with the removal of the overburden. For simplicity, the removal of the overburden is accounted for in the construction phase emissions summary above. However, it is understood that some of the overburden will be removed in stages during the operation of the Project. Emissions related to construction activities are expected to be fairly localized.

The surface of the stockpiled topsoil and overburden piles will naturally harden and naturally re-vegetate over time; therefore, fugitive emissions from wind erosion of the topsoil and overburden storage piles are not anticipated.

Fugitive dust emissions associated with vehicle traffic along unpaved or paved on-site haul roads were not included in this assessment. On-site road conditions will be reviewed daily and water trucks will be used, when required, to mitigate fugitive dust generation.

With respect to sound quality, modelling was conducted to further asses construction related noise using the Roadway Construction Noise Model (RCNM) (USDOT 2018). Modelling was conducted assuming that two excavators and four trucks are operating simultaneously in the centre of the quarry, with the dozer, loader, and one truck operating in the centre of the storage area (where the overburden is assumed to be stored, for the purposes of this model). This set up represents the worst-case scenario of maximum potential sound power levels closest to the two nearest residential receptors to the north (Receptor 1) and south (Receptor 2) of the Project site (**Figure 5.2.1**). It was also conservatively assumed there was no natural shielding of noise, despite the presence of a treed buffer. The results of the noise modelling during construction are presented in **Table 5.2.5**.

Table 5.2.5: Noise Modelling Results – Construction Phase

Equipment	Equipment Lmax (dBA)	Distance to Receptor 1 (m)	Predicted Leq at Receptor 1 (North) (dBA)		Distance to Receptor 2 (m)	Predicted Leq at Receptor 2 (South) (dBA)	
			Lmax	Leq		Lmax	Leq
Dozer	81.7	680	48.7	44.7	640	49.2	45.2
Excavator	80.7	415	52.0	48.0	913	45.2	41.2
Excavator	80.7	415	52.0	48.0	913	45.2	41.2
Front End Loader	79.1	680	46.1	42.1	640	46.6	42.7
Truck	76.5	680	43.5	39.5	640	44.0	40.0
Truck	76.5	415	47.7	43.8	913	40.9	36.9
Truck	76.5	415	47.7	43.8	913	40.9	36.9
Truck	76.5	415	47.7	43.8	913	40.9	36.9
Truck	76.5	415	47.7	43.8	913	40.9	36.9
TOTAL	--	--	**52.0**	**54.4**	--	**49.2**	**50.3**

The predicted sound pressure level at each residential receptor modelled were well below the daytime typical industry benchmark of 65 dBA and below the nighttime typical industry benchmark of 55 dBA, both as a 1-hour Leq.

Operation Phase

Air emissions during the operation phase are primarily related to the operation of mobile equipment, trucking (on-site and off-site), material transfer activities, and blasting activities. These activities have the potential to result in changes in the local air quality primarily related to fugitive dust and particulate matter from material movement as well as emissions from combustion associated with on-site equipment.

Estimates of emissions associated with the operation phase of the Project are summarized in **Table 5.2.6**.

Table 5.2.6: Annual Emissions Associated with Operation

Air Contaminant	Blasting	Excavating	Crushing	Grading	Stockpiling	Trucking	Total
TSP (tonnes/yr)	0.301	0.829	0.898	0.410	14.988	0.445	**17.872**
PM_{10} (tonnes/yr)	0.235	0.536	0.448	0.121	3.551	0.445	**5.336**
$PM_{2.5}$ (tonnes/yr)	0.222	0.312	0.103	0.014	2.018	0.361	**3.032**
CO (tonnes/yr)	1.374	2.632	0.853	0.014	4.995	4.324	**14.192**
NO_X (tonnes/yr)	0.443	4.159	1.348	0.022	7.895	9.895	**23.762**
SO_2 (tonnes/yr)	0.083	0.223	0.072	0.001	0.424	0.151	**0.955**
CO_2e (tonnes/yr)	13.808	408.338	132.386	2.177	775.098	2,608.650	**3,940.458**

Notes: Emission Factors from AP-42, Sections 3.3, 11.9, 11.19, 13.2.4 and 13.3 (USEPA 2022a).
Emission modeling completed by using the US EPA Motor Vehicle Emissions Simulator (MOVES; USEPA 2022b).
Blasting emissions include fugitive dust and combustion emissions from drilling, and blasting.
On-site Trucking includes combustion emissions from transport of material on-site and from water trucks.
Stockpiling includes emissions form the loader and dozer operations.

The majority of dust emissions observed during the operation phase are related to fugitive dust from material transfer activities associated with the removal of the gypsum. There are additional activities of blasting and crushing during the operation phase of the Project that have the potential to contribute to fugitive emissions. The fugitive dust emissions will largely be localized to the activity at the site and primarily during blasting activities.

The majority of emissions associated with combustion products during the operation phase are related to the trucking of material along the off-site haul route. The concentrations of some pollutants can be substantially above their respective regional levels within approximately 100 metres of major local roads and 500 metres of major highways. The extent of this elevation may depend on many factors, particularly traffic volume and meteorological conditions.

Fugitive emissions are not anticipated from the stockpiled gypsum, due to the nature and size of the material stored (i.e., 15-20 cm diameter rocks, rather than a finely crushed powder). As a result, fugitive emissions are not anticipated to have a substantive impact on air quality beyond the property boundary.

Fugitive dust emissions associated with vehicle traffic along unpaved or paved on-site haul roads were not included in this assessment. On-site road conditions will be reviewed daily and water trucks will be used, when required, to mitigate fugitive dust generation.

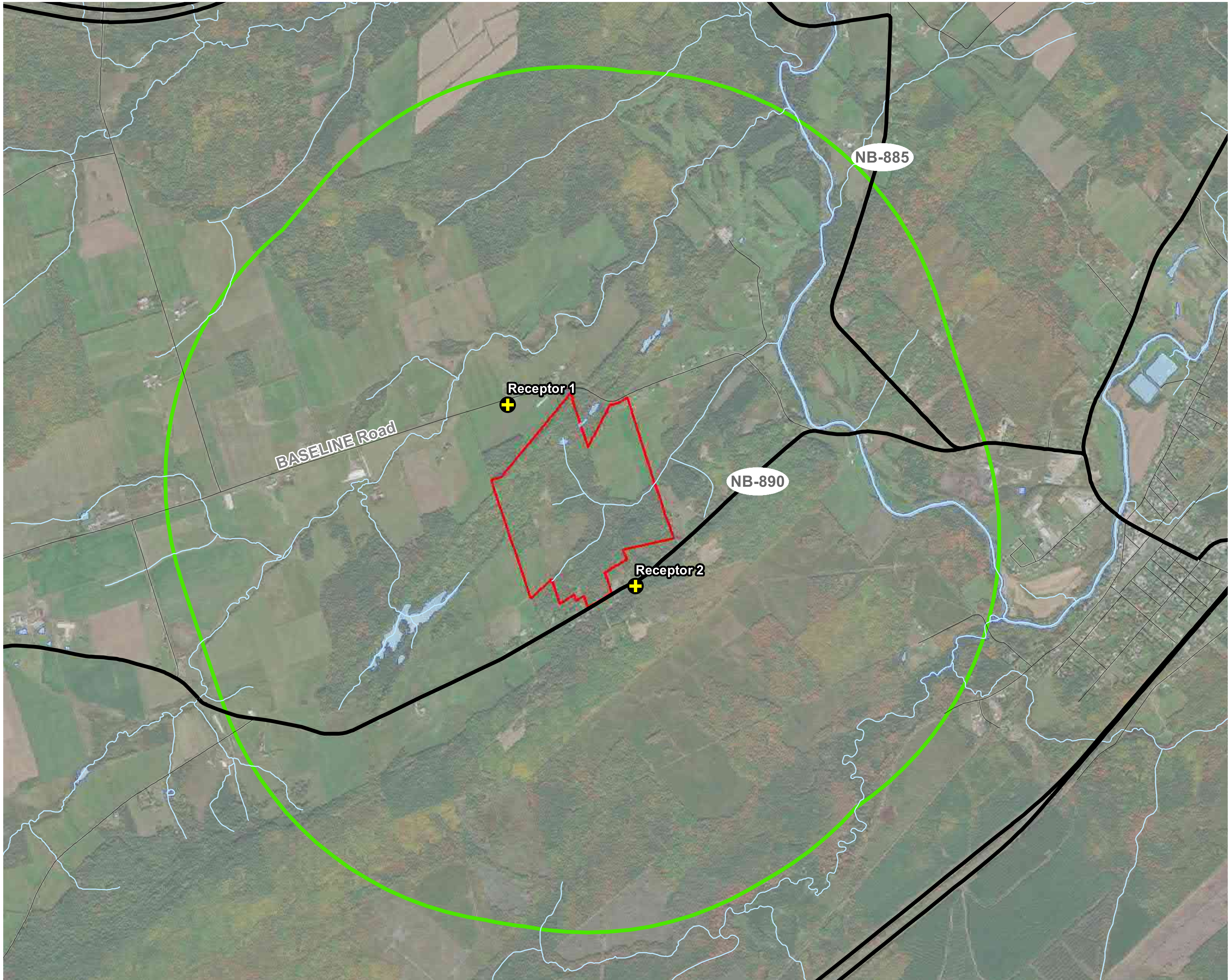
With respect to climate, total greenhouse gas emissions during operation are estimated to be 3,940 tonnes/year of CO_2e, which represents approximately 0.003% of New Brunswick's last reported total of 12.4 Mt CO_2e in 2020.

Based on the low magnitude of annual emissions during operation, ambient air quality is not expected to be affected as a result of the Project. Given the low magnitude of these emissions and the intermittent operation of the Project, dispersion modelling was not determined to be required.

With respect to sound quality, modelling was conducted to further assess operation-related noise using the Roadway Construction Noise Model (RCNM) (USDOT 2018). Modelling was conducted assuming that two excavators, crusher, driller, and four trucks are operating simultaneously in the centre of the quarry, with the dozer, loader, and one truck operating in the centre of the storage area. It should be noted that noise generated from blasting was not modelled in this scenario, as it is infrequent and of short duration (i.e., instantaneous impulse). Drilling associated with preparations for blasting was included. This set up represents the worst-case scenario of maximum potential sound power levels closest to the two nearest residential receptors to the north and south of the Project site (**Figure 5.2.1**). It was also conservatively assumed there was no natural shielding of noise, despite the presence of a treed buffer and the fact that operations in the open pit/quarry will be conducted at depth, with the pit walls providing some shielding of noise emissions compared to those that would result if the equipment were located at surface. These result in a conservative prediction of anticipated noise levels arising from the Project. The results of the noise modelling during operation are presented in **Table 5.2.7**.

Table 5.2.7: Noise Modelling Results – Operation Phase

Equipment	Equipment Lmax (dBA)	Distance to Receptor 1 (m)	Predicted Leq at Receptor 1 (North) (dBA)		Distance to Receptor 2 (m)	Predicted Leq at Receptor 2 (South) (dBA)	
			Lmax	Leq		Lmax	Leq
Dozer	81.7	680	48.7	44.7	640	49.2	45.2
Excavator	80.7	415	52.0	48.0	860	45.7	41.7
Excavator	80.7	415	52.0	48.0	860	45.7	41.7
Front End Loader	79.1	680	46.1	42.1	640	46.6	42.7
Truck	76.5	680	43.5	39.5	640	44.0	40.0
Truck	76.5	415	47.7	43.8	860	41.4	37.4
Truck	76.5	415	47.7	43.8	860	41.4	37.4
Truck	76.5	415	47.7	43.8	860	41.4	37.4
Truck	76.5	415	47.7	43.8	860	41.4	37.4
Drilling	81.0	415	52.3	45.3	860	46.0	39.0
Crushing	85.0	415	56.3	53.3	860	50.0	47.0
TOTAL	-	-	**56.3**	**57.2**	-	**50.0**	**52.3**



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NOISE MODEL RECEPTOR LOCATIONS
FIGURE 5.2.1

- Noise Model Receptor Locations
- Road
- Highway
- Watercourse
- Local Assessment Area
- Waterbodies (GeoNB)
- Project Development Area

0 0.125 0.25 0.5 Kilometers

SCALE 1:23,000

N W E S

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STATUS: FINAL
DATE: 2022-11-08

FILE LOCATION: \\tr1vmgissrv01\GIS\2022\224280\Product\Client\Glenvale\Figure 5.2.1 Noise Model Receptor Locations.mxd

The predicted sound pressure level at each modelled residential receptor were well below the daytime typical industry benchmark of 65 dBA as a 1-hour Leq. The worst-case modelling predicted 1-hour Leq at Receptor 1 was 57.2 dBA, which is just above the nighttime typical industry benchmark of 55 dBA; however, operations in the quarry are not expected to occur during nighttime (even though they were conservatively modelled in this scenario), and therefore the actual levels at this receptor are expected to be far below 55 dBA at nighttime. The predicted 1-hour Leq at Receptor 2 was within the nighttime typical industry benchmark of 55 dBA.

Given the relative distance between Project activities and the nearest residential receptors, blasting activities are not expected to result in measurable vibration levels that could cause property damage. Blasting activities will be limited to approximately 25 blasts per year as an annual average (excluding nights, weekends, and statutory holidays), and a communication plan will be developed for residents who wish to be notified. Blasting activities will be periodically monitored using a seismograph to verify that concussion noise levels do not exceed a peak pressure level limit of 128 decibels (dBL) and that peak particle velocities (PPV) remain within 1.25 cm/s, as a best industry practice for quarry operations.

Reclamation and Closure Phase

Activities during the reclamation and closure phase are expected to be similar in nature to those occurring during construction (though somewhat in reverse order). Though not specifically quantified for the reclamation and closure phase, emissions of air contaminants, noise, and vibration are expected to be similar to, or less than, those could occur during construction. As such, environmental effects on the atmospheric environment during the reclamation and closure phase are not expected to be substantive.

5.2.4 Summary

The effects of construction on ambient air quality due to fugitive dust and emissions from equipment are expected to be localized and minimal, using standard and site-specific mitigation as identified. Appropriate mitigative measures will be taken when required so that nuisance dust levels are controlled such that they do not cause an exceedance of ambient air quality standards at the property line or a nuisance at nearby residential receptors. It is unlikely that emissions will exceed New Brunswick or federal air quality standards beyond the property boundary for the Project.

The sound pressure levels related to on-site activities are not predicted to exceed the criteria for daytime for both construction and operation.

Greenhouse gas emissions from the Project are not anticipated to materially contribute to overall emissions in the region.

In light of the above, and in consideration of the nature of the Project, its anticipated environmental effects, and the implementation of mitigation and best practices that are known to reduce environmental effects, the residual environmental effects of the Project on the atmospheric environment during each phase of the Project are rated not significant, with a high level of confidence.

Baseline noise monitoring is planned for the spring of 2023. The results of this monitoring will be detailed and provided in a supplementary report as an addendum to the EIA registration document. No other follow-up or monitoring is proposed, though it is anticipated that monitoring of dust or noise emissions may be required as part of the Project's Approval to Operate to be issued under the New Brunswick *Air Quality Regulation.*

5.3 Water Resources

The potential environmental effects of the Project on water resources are assessed in this section.

5.3.1 Scope of VC

Water is essential for life on Earth. As humans, we need water for drinking, bathing, sanitation, recreation, and for the production of food and goods. Fish, birds, animals, and plants also rely on the availability of water to live and flourish. Changes in the availability of water, both in the amount of water and the quality of the water, may affect the lives of people and other living things.

In this document, water resources include groundwater and surface water resources available for use by humans and wildlife (including vegetation). Water resources was selected as a VC based on the importance of the resource, and because of the potential for these resources to be affected by the Project through changes in surface water or groundwater quality or quantity.

The water resources VC can be discussed as two separate elements: surface water and groundwater. Surface water consists of wetlands, watercourses (mapped and unmapped), water bodies, and surface water drainage channels that are within the property boundary or within the areas that may be potentially affected by the Project. Watercourses and areas meeting the definition of a wetland in New Brunswick, are regulated by the New Brunswick *Clean Water Act* including its *Watercourse and Wetland Alteration Regulation,* and the New Brunswick *Wetlands Conservation Policy* (NBDNRE-NBDELG 2002). Wetlands are further discussed and assessed in **Section 5.5**. Surface water supplies used as public drinking water sources are protected under the *Watershed Protected Area Designation Order - Clean Water Act.*

Groundwater consists of water that is contained within the ground and recharged through infiltration of precipitation or surface water, and is important to local ecosystems and private potable wells. In general, groundwater flows from recharge areas (i.e., areas of high elevation) to discharge areas (i.e., areas of low elevation), which are commonly lakes, streams, and rivers. Groundwater is contained in aquifers, which are geological units such as gravels, sands, or fractured bedrock. The quality of the water contained in aquifers varies depending on the geochemical composition of the material within which the water flows. The construction of potable wells and the extraction of groundwater is regulated under the New Brunswick *Clean Water Act* and associated *Water Well Regulation* and *Potable Water Regulation*. Groundwater sources used as public drinking water supplies are protected under the *Wellfield Protected Area Designation Order - Clean Water Act.*

Objectives for the quality of surface water and groundwater as a source of drinking water are provided in Health Canada's *Guidelines for Canadian Drinking Water Quality* (GCDWQ) (Health Canada 2022). Though not having force of law unless formally adopted by provincial legislation, these guidelines provide guidance to decision-makers with respect to the potability of drinking water for human use.

The groundwater and surface water environment are considered VCs as they are an important part the hydrologic cycle, are critical to the water balance, and are contributing components to both ecological and human health. The overall groundwater environment includes consideration of potential effects on both surface water and groundwater quality as well as quantity.

5.3.1.1 Temporal Boundaries

The temporal boundaries for the Project include the following:

- **Construction**: extending for a period of approximately four months, anticipated to begin in the fourth quarter (Fall) of 2023 (subject to the receipt of all approvals and permits required for the Project);
- **Operation**: beginning in approximately the first quarter of 2024, and lasting for approximately 10 years or until the mineral resource has been depleted; and,
- **Reclamation and closure**: to be initiated following the completion of operations at the site, with decommissioning and reclamation of the surface facilities at the site for an anticipated duration of six months following operation.

5.3.1.2 Spatial Boundaries

The Project development area (PDA) is defined as the area of physical disturbance associated with construction and operation of the Project. Specifically, the PDA consists of an area of approximately 85 ha (i.e., conservatively assumed to be the entirety of PIDs 00814160, 70076948, and 70654058) that includes the open pit and all related surface facilities located on the property. The PDA is the area represented by the physical Project footprint.

The local assessment area (LAA) is the maximum anticipated area within which Project-related environmental effects are expected. For water resources, the LAA is defined by the North River to the east, Salt Springs Brook to the north and west, and Route 890 to the south. The LAA includes the PDA and adjacent areas where Project-related environmental effects could be expected to occur.

5.3.1.3 Significance Threshold

A significant adverse residual environmental effect on water resources is one where Project-related activities:

- degrade the quality of previously unaffected surface water or groundwater by exceeding the objectives of one or more parameters as specified in the Guidelines for Canadian Drinking Water

Quality (Health Canada 2022) for potable domestic water supplies for a period of more than 30 days;

- result in a significant loss of provincially significant watercourses or wetlands that cannot be compensated for as defined by the New Brunswick Wetlands Conservation Policy (NBDNRE-NBDELG 2002);
- cause a significant geochemical alteration or dewatering of the North River, ultimately impacting the Petitcodiac River; or,
- reduce the quantity of groundwater recoverable from an aquifer on a sustainable basis such that it no longer meets present or future needs of current users or land owners.

5.3.2 Existing Conditions

The existing conditions for water resources are defined below in terms of surface water resources and groundwater resources.

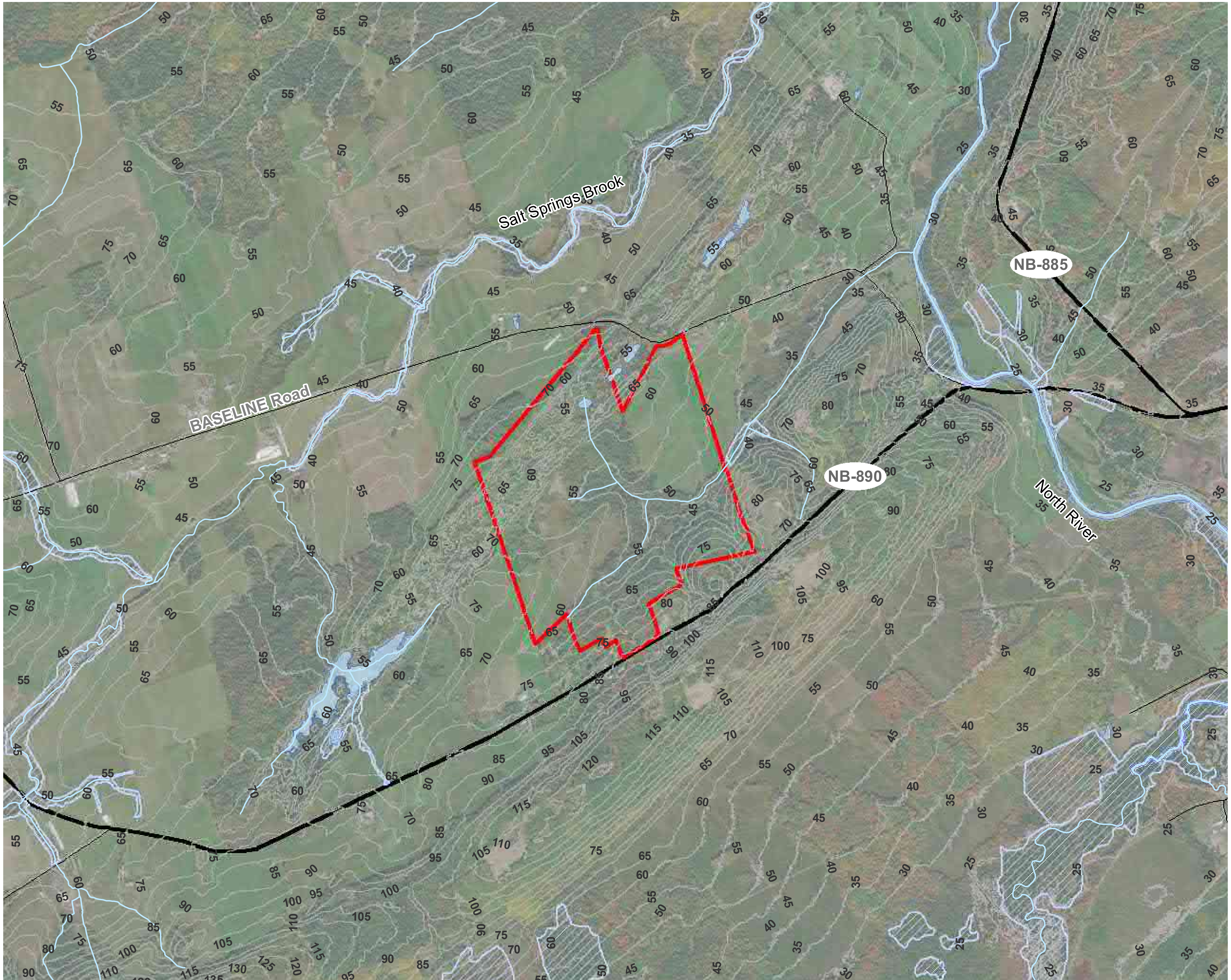
5.3.2.1 Surface Water Resources

The Project is located in southeastern New Brunswick, approximately 4 km northwest of the village of Petitcodiac and lies within the Petitcodiac River watershed. The Petitcodiac River ultimately discharges into the Shepody Bay which in turns flows into the eastern portion of the Bay of Fundy. The Petitcodiac River has a total drainage area of approximately 2,831 km^2 (NBDELG 2007). The Petitcodiac River originates as the North River in Indian Mountain, and runs in a southwesterly direction for a distance of approximately 34 km (straight-line distance) until it meets the Anagance River and becomes the Petitcodiac River in the village of Petitcodiac. The Petitcodiac River then takes an abrupt turn and flows northeast for approximately 40 km to the city of Moncton and then south for approximately 30 km into Shepody Bay.

Figure 5.3.1 presents the general site location and general topographical features of the site. The topography of the Project site rises to over 70 m above mean sea level (m amsl) in the northern portion of the Project site, and slopes downward towards the central portion of the property (approximately 50 m amsl), and rising again to the south towards Route 890 (approximately 90 m amsl).

A number of the wetlands are interconnected by small watercourses and unnamed tributaries of the North River that may only contain water during recharge events and seasonal run-off. A detailed description of each wetland is presented in **Section 5.5**.

There are three small mapped watercourses that intersect the PDA, as shown in **Figure 5.3.1**. Water quality information for these watercourses is provided in **Section 5.4.2**.



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SURFACE WATER RESOURCES
FIGURE 5.3.1

- Watercourse
- Waterbodies (GeoNB)
- Wetland (NBDELG 2021)
- Contours 5m Intervals
- Project Development Area
- Road
- Highway

0 100 200 400 Meters

SCALE 1:15,000

N
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STATUS: FINAL
DATE: 2022-09-21

FILE LOCATION: K:\2022\224280\Product\Client\Glenvale\Figure5.3.1 Surface Water Resources.mxd

5.3.2.2 Groundwater Resources

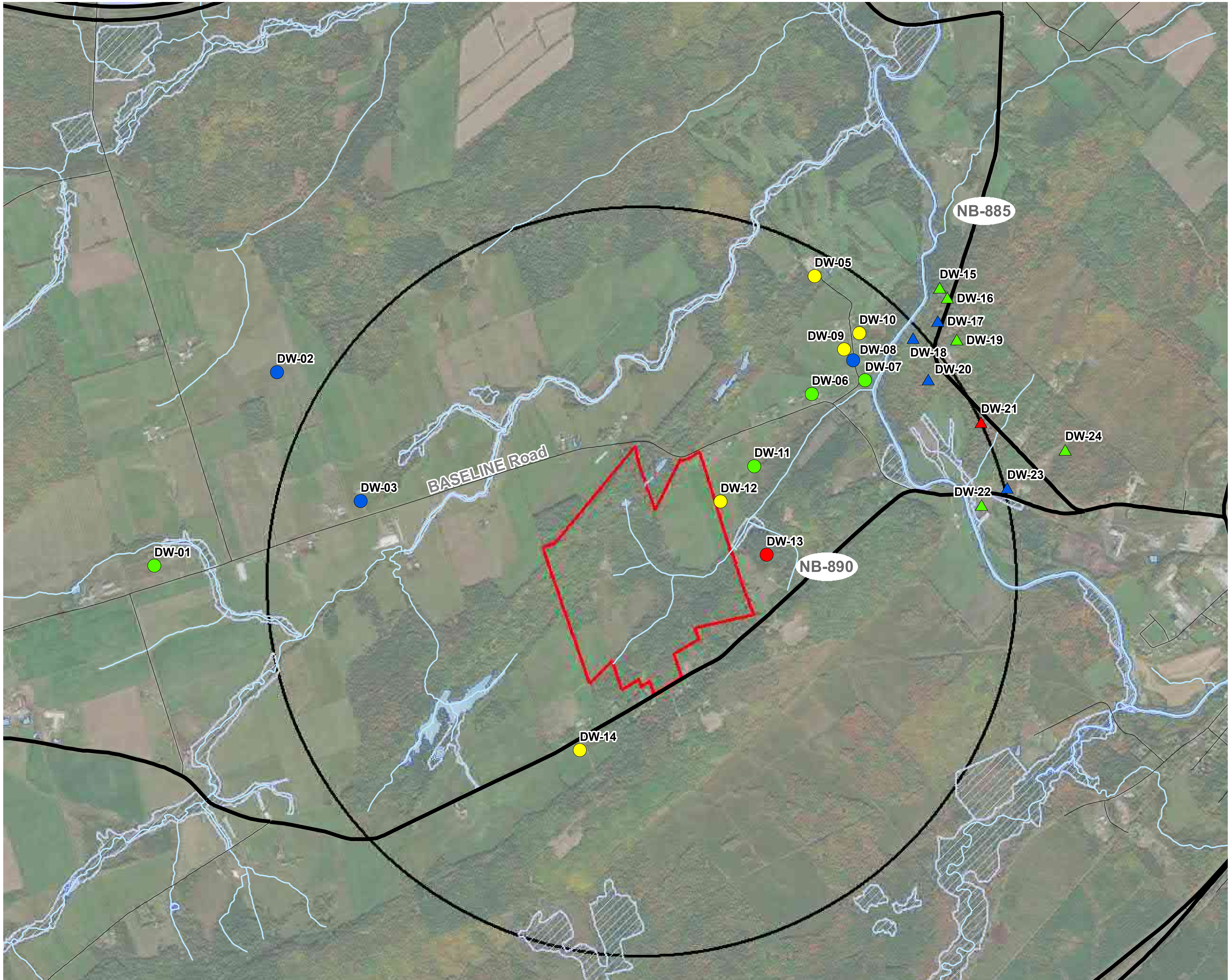
The surficial geology of the PDA consists of the Horton/Cumberland Till, a brownish-red till consisting of >80% sedimentary clasts originating from the Horton and Cumberland groups (Pronk et al. 2005). Surficial materials in the Project area consists of overburden thickness ranging from 0 to 11 m based on the exploration work. Shallower to virtually no overburden is present over much of the deformed sulphates to the southeast of the melange unit, while generally thicker cover mostly comprising unconsolidated but compact red mud, sandy mud and silt to the northwest over the massive sulphates. Karsting is extremely well developed over the southeastern unit and apparently much less so the northwest.

The bedrock geology of the area is made up of the Carboniferous Windsor Group trending in a northeast-southwest direction. The Windsor Group consists of the Macumber and Upperton formations; the Macumber Formation is mostly grey to tan and pink wackestone and packstone while the Upperton Formation is primarily gypsum and anhydrite (St. Peter 2006). Pre-Windsor Group rocks of the Gautreau and Weldon formations are present to the northwest, consisting of mudstones, shale, sandstones, conglomerate, and limestone (St. Peter 2006). To the southeast, post-Windsor Group rocks consists of the Mabou Group and Salisbury Formation, predominately sandstones and mudstones. Gays River Formation and the Macumber Formation (St. Peter 2006).

Karst features are openings in bedrock caused by the dissolution of bedrock material by groundwater over long periods of time. Depending on their age, these features may be filled with mud or debris. Karst features typically occur in limestone and gypsum related bedrock, and were noted in the area of the PDA, including sinkholes observed at the surface in multiple locations. During exploration drilling activities at the Project site, voids were encountered in the gypsum and anhydrite, up to 5 m in vertical thickness, indicating that subterranean karst features may also be present. Due to the intrinsic low permeability of gypsum and anhydrite along with the observation of backfilled karstic features, it is not likely that significant groundwater flow is present within the gypsum and/or anhydrite deposits.

From a recharge to groundwater perspective, the PDA has topographic highs at the northern and southern end of the properties and a topographic low in the central portion. To gain a better understanding of the known sources of groundwater in the area, a desktop review of the New Brunswick Online Well Log System (OWLS; NBDELG 2022c) search was completed by Dillon. For the review, a search radius of 2 km was selected. It should be noted that the radial search is property based, and the OWLS will return wells that are affiliated with any property in which a portion of the property falls within the search radius. Therefore, the wells discussed may be located beyond the 2 km search radius surrounding the subject property. Another important limitation of the OWLS database is that it includes only wells that were completed after 1994; thus, there may be other wells present in an area if they existing prior to that year.

The OWLS query yielded results for 24 water wells near or within the 2 km radius surrounding the PDA (**Figure 5.3.2**). Several of the identified wells are located to the east of the North River; it is therefore likely these wells are hydrogeologically separated from the groundwater associated with the Project and are classified as outside the LAA. The wells are included in the discussion below for completeness. Available information regarding well construction details is outlined below in **Table 5.3.1**.



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DOMESTIC WELL LOCATION
FIGURE 5.3.2

Domestic Well Inside Local Assessment Area
Domestic Well Outside Local Assessment Area
Excellent (>60)
Very Good (30-60)
Good (10-30)
Marginal (5-10)
Insuffient (0-5)
Road
Highway
Watercourse
Waterbodies (GeoNB)
Wetland (NBDELG 2021)
Search Radius (2km)
Project Development Area

0 0.125 0.25 0.5 Kilometers
SCALE 1:20,000
N W E S

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DATE: 2022-09-21

FILE LOCATION: K:\2022\224280\Product\Client\Glenvale\Figure 5.3.1 Domestic Well Locations.mxd

Table 5.3.1: Well Construction Details for 24 Wells within Approximately 2 km of the Project (NBDELG 2022c)

Well Identification	LAA	Overall Well Depth (m)	Well Casing Diameter (cm)	Well Casing Depth (m)	Estimated Safe Yield (litres per minute)
DW-01	Inside	37.19	15.24	26.82	54.60
DW-02	Inside	42.67	15.24	21.34	136.50
DW-03	Inside	24.38	15.24	8.69	91.00
DW-04	Inside	24.38	12.70	14.63	36.40
DW-05	Inside	52.43	15.24	34.75	29.58
DW-06	Inside	25.91	15.24	22.56	45.50
DW-07	Inside	24.38	15.24	11.58	36.40
DW-08	Inside	42.67	15.24	21.34	136.50
DW-09	Inside	62.48	15.24	36.58	22.75
DW-10	Inside	47.24	15.24	39.32	22.75
DW-11	Inside	21.95	15.24	11.58	45.50
DW-12	Inside	56.69	15.24	32.61	18.20
DW-13	Inside	60.96	15.24	24.69	4.55
DW-14	Inside	43.89	15.24	20.12	20.48
DW-15	Outside	18.29	15.24	6.10	31.85
DW-16	Outside	18.29	15.24	6.10	31.85
DW-17	Outside	23.16	15.24	6.40	91.00
DW-18	Outside	23.16	15.24	6.40	91.00
DW-19	Outside	21.95	15.24	7.62	36.40
DW-20	Outside	23.16	15.24	6.40	91.00
DW-21	Outside	64.01	15.24	6.55	2.28
DW-22	Outside	25.60	15.24	7.92	45.50
DW-23	Outside	42.67	15.24	21.34	136.50
DW-24	Outside	24.38	15.24	19.51	45.50

Notes:

1. The estimated safe yield is based upon the well driller's estimate at the time of well drilling and may not represent the long-term sustainability of the well.

Observed stratigraphy is recorded by the licensed well drillers during each well installation. Available information regarding observed stratigraphy is presented below in **Table 5.3.2**.

Table 5.3.2: Stratigraphy information for the 24 wells within Approximately 2 km of the Project (NBDELG 2022c)

Well Identification	Depth of Top of Zone (mbgs)	Depth of Bottom of Zone (mbgs)	Stratigraphy
DW-01	0.00	2.44	Brown Clay and Mud
	2.44	37.19	Brown Shale
DW-02	0.00	5.49	Grey Sandstone
	5.49	19.81	Brown Clay
	19.81	36.58	Grey Sandstone
	36.58	42.67	Brown Clay
DW-03	0.00	2.13	Brown Clay and Mud
	2.13	6.40	Brown Shale
	6.40	24.38	Brown Sandstone
DW-04	0.00	1.52	Brown Fill
	1.52	4.57	Brown Gravel and Mud and Clay
	4.57	24.38	Grey Shale
DW-05	0.00	2.44	Brown Clay and Mud
	2.44	52.43	Brown Shale
DW-06	0.00	3.35	Brown Clay and Mud
	3.35	25.91	Brown Shale
DW-07	0.00	1.83	Brown Mud and Fill
	1.83	24.38	Brown Shale
DW-08	0.00	5.49	Grey Sandstone
	5.49	19.81	Brown Clay
	19.81	36.58	Grey Sandstone
	36.58	42.67	Brown Clay
DW-09	0.00	32.00	Black Clay
	32.00	33.53	Brown and grey Broken Rock
	33.53	62.48	Brown and grey Conglomerate
DW-10	0.00	3.66	Brown Clay and Mud
	3.66	47.24	Brown Sandstone
DW-11	0.00	2.44	Brown Clay and Topsoil
	2.44	21.95	Brown Shale
DW-12	0.00	2.44	Brown Clay and Mud
	2.44	56.69	Brown Shale
DW-13	0.00	4.57	Brown Sand
	4.57	60.96	Brown Sandstone
DW-14	0.00	15.24	Red Overburden
	15.24	43.89	Red Conglomerate

Well Identification	Depth of Top of Zone (mbgs)	Depth of Bottom of Zone (mbgs)	Stratigraphy
DW-15	0.00	1.22	Brown Till
	1.22	5.49	Brown Shale
	5.49	18.29	Brown Rock
DW-16	0.00	1.22	Brown Till
	1.22	5.49	Brown Shale
	5.49	18.29	Brown Rock
DW-17	0.00	0.91	Brown Clay and Mud
	0.91	4.88	Brown Sand and Gravel
	4.88	23.16	Brown Sandstone
DW-18	0.00	0.91	Brown Clay and Mud
	0.91	4.88	Brown Sand and Gravel
	4.88	23.16	Brown Sandstone
DW-19	0.00	1.83	Brown Till
	1.83	8.53	Brown Shale
	8.53	21.95	Brown Sandstone
DW-20	0.00	0.91	Brown Clay and Mud
	0.91	4.88	Brown Sand and Gravel
	4.88	23.16	Brown Sandstone
DW-21	0.00	0.91	Brown Gravel
	0.91	13.72	Brown Sandstone
	13.72	17.68	Grey Shale
DW-22	0.00	0.91	Brown Topsoil
	0.91	5.49	Brown Sandstone
	5.49	7.32	Grey Shale
DW-23	0.00	5.49	Grey Sandstone
	5.49	19.81	Brown Clay
	19.81	36.58	Grey Sandstone
	36.58	42.67	Brown Clay
DW-24	0.00	1.22	Brown Clay and Mud
	1.22	21.34	Brown Shale
	21.34	24.38	Grey Shale
	1.22	21.34	Brown Shale
	21.34	24.38	Grey Shale

Notes:

1. The stratigraphy is based upon the observations of drill cutting made by the well driller at the time of drilling. The stratigraphy should be considered as a general description only and not an interpreted geologic unit.
2. Mbgs = metres below ground surface

Available information regarding water bearing zones observed during well construction is presented below in **Table 5.3.3**.

Table 5.3.3: Water Bearing Zones for 24 Wells Within Approximately 2 km of the Project (NBDELG 2022c)

Well Identification	Water Bearing Zone Depth (m)	Estimated Water Flow Rate (L/min)
DW-01	28.19	4.55
	35.81	54.60
DW-02	36.58	136.50
DW-03	24.38	91.00
	14.63	9.10
DW-04	15.24	4.55
	19.81	22.75
	23.77	36.40
DW-05	51.82	29.58
DW-06	24.38	45.50
DW-07	22.10	36.40
	16.00	13.65
DW-08	36.58	136.50
DW-09	59.44	22.75
DW-10	39.62	9.10
	47.24	22.75
DW-11	15.24	9.10
	21.34	45.50
DW-12	42.67	4.55
	54.86	18.20
DW-13	60.96	4.55
DW-14	21.34	2.28
	36.58	9.10
	39.62	9.10
DW-15	8.53	9.10
	18.29	31.85
DW-16	8.53	9.10
	18.29	31.85
DW-17	22.86	91.00
DW-18	22.86	91.00
DW-19	26.82	36.40
DW-20	22.86	91.00
DW-21	22.56	2.28
DW-22	12.19	4.55

Well Identification	Water Bearing Zone Depth (m)	Estimated Water Flow Rate (L/min)
	19.81	22.75
	23.77	36.40
	25.60	45.50
DW-23	36.58	136.50
DW-24	24.38	45.50

Notes:

1. The estimated water flow rate is a representation of the well driller's estimate of the yield of each water bearing fracture identified during the drilling of the well.

In accordance with the New Brunswick *Clean Water Act*, the OWLS database does not attribute reported water quality analytical data to its corresponding well. The OWLS search completed as part of this assessment yielded analytical data for 10 samples. The reported analytical data are presented in **Table 5.3.4**. For reference, the data have been compared to the applicable Health Canada Guidelines for Canadian Drinking Water Quality (Health Canada 2022).

Additionally, the analytical results for general chemistry and trace metals were used to develop a trilinear Piper plot to illustrate and summarize the chemical composition of the water samples relative to major ionic constituents. The trilinear Piper plot is presented on **Figure 5.3.3**.

Based upon the results of the OWLS search and water chemistry review, the following assumptions have been made.

- According to the observed stratigraphy and well construction details, the wells included in the OWLS search appear to be constructed to source groundwater from bedrock, with casing installed into bedrock.
- Based on the observed stratigraphy and water bearing data, it appears that the wells from the OWLS database search did not encounter gypsum.
- The water quality analytical data indicate arsenic and manganese were above the Health Canada (2022) GCDWQ health-based guideline in Well DW-3 and Well DW-6, respectively. The Health Canada (2022) GCDWQ aesthetic-based guideline was exceeded for iron, manganese, and total dissolved solids in at least one well. The exceedances are likely due to the dissolution of the naturally occurring minerals.
- The topography of the LAA suggests that groundwater is anticipated to flow from the site to the east/southeast towards the North River. Elevation contours are displayed on **Figure 5.3.1**.

TABLE 5.3.4
GENERAL CHEMISTRY AND TRACE METALS - OWLS SURVEY ANALYTICAL DATAA
Glenvale Gypsum Quarry Project
Glenvale, New Brunswick
Project No. 22-4280

Parameter	Units	GCDWQ (2022)[A]		Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8	Sample 9	Sample 10
		AO[B]	MAC[C]										
General Chemistry													
Calcium	mg/L	-	-	95.2	180	41.4	46.4	40.3	216	47.2	78.7	92.3	25.6
Chloride	mg/L	250	-	33.2	7.75	13.4	5.04	1.7	9.2	133	54.2	44.5	1.73
Conductivity	µS/cm	-	-	567	837	365	269	281	1,120	560	464	659	213
Copper	mg/L	-	-	0.1	<0.010	<0.010	<0.010	<0.010	<0.010	0.038	0.015	<0.010	0.087
Flouride	mg/L	-	1.5	<0.1	<0.1	0.15	0.117	0.107	0.236	<0.1	0.112	<0.1	0.108
Hardness	mg/L	-	-	253	460	155	126	144	599	152	216	274	68.8
Iron	mg/L	0.3	-	<0.010	0.181	0.263	0.086	**0.955**	**1.96**	0.017	0.072	0.261	0.063
Magnesium	mg/L	-	-	3.67	2.68	12.5	2.51	10.5	14.4	8.24	4.7	10.6	1.18
Manganese	mg/L	0.02	0.12	<0.005	0.009	0.009	<0.005	0.008	**0.14**	**0.077**	T	**0.064**	0.006
Nitrate + Nitrite (as N)	mg/L	-	10[D]	0.16	0.37	2.5	0.43	1.5	0.8	0.58	1.5	3	0.94
pH	no units	7.0 - 10.5	-	7.88	7.32	8.14	8.09	8.24	8.05	6.93	8.04	7.67	8.49
Potassium	mg/L	-	-	0.41	3.38	0.6	1.4	0.9	1.3	1.3	0.78	1.76	0.454
Sodium	mg/L	200	-	13.6	7.84	20.6	5.12	3.96	10.7	45.1	4.02	30	15.6
Sulphate	mg/L	500	-	126	268	47.6	3.38	3.67	459	5.61	5.96	78.1	4.11
Total Alkalinity	mg/L	-	-	124	178	117	123	128	137	54.5	139	192	103
Total Dissolved Solids	mg/L	500	-	347	578	218	140	146	799	276.1	NA	NA	NA
Turbidity	NTU	-	-	0.02	1	2.4	0.98	5	26	0.5	0.3	5.9	1.1
Calculated Parameters													
Bicarbonate as CaCO3	mg/L	-	-	124	178	117	122	126	136	54.45	NA	NA	NA
Carbonate as CaCO3	mg/L	-	-	0.00	0.00	0.00	1.40	2.10	1.40	0.04	NA	NA	NA
Hydroxide as CaCO3	mg/L	-	-	0.00	0.00	0.00	0.10	0.10	0.10	0.00	NA	NA	NA
Cation sum	EPM	-	-	5.66	9.64	4.02	2.79	3.13	12.58	5.04	NA	NA	NA
Anion sum	EPM	-	-	6.05	9.39	3.90	2.72	2.83	12.64	5.01	NA	NA	NA
Theoretical Conductivity	µS/cm	-	-	566	860	364	239	249	1,214	519	NA	NA	NA
Microbiology													
E.coli	no units	-	Ab	Ab	Ab	Ab	Ab	Ab	Ab	NA	Ab	Ab	Ab
Total Coliforms	no units	-	Ab	Ab	Ab	Pr	Ab	Ab	Pr	NA	Ab	Pr	Ab
Trace Metals													
Aluminum	µg/L	100	2,900	<25	<25	<25	<25	<25	<25	<25	<25	<25	40
Antimony	µg/L	-	6	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Arsenic	µg/L	-	10	1.5	1.5	**39**	1.5	2.6	1.5	1.5	2.9	1	5.8
Barium	µg/L	-	2,000	45	39	126	559	510	173	406	1,050	38	312
Boron	µg/L	-	5,000	20	43	74	26	15	135	13	T	<200	<200
Bromide	µg/L	-	-	<100	<100	<100	<100	<100	<100	<100	NA	<100	<100
Cadmium	µg/L	-	7	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.1	<0.5	<0.5
Calcium	µg/L	-	-	95,200	180,000	41,400	46,400	40,300	216,000	47,200	78,700	92,300	25,600
Chromium	µg/L	-	50	14	17	<10	<10	<10	<10	<10	T	21	<10
Copper	µg/L	-	-	100	<10	<10	<10	<10	<10	38	15	<10	87
Iron	µg/L	300	-	<10	181	263	86	**955**	**1,960**	17	72	261	63
Lead	µg/L	-	5	<1	<1	<1	<1	<1	<1	1.1	2.5	1.5	<1
Magnesium	µg/L	-	-	3,670	2,680	12,500	2,510	10,500	14,400	8,240	4,700	10,600	1,180
Manganese	µg/L	20	120	<5	9	9	<5	8	**140**	**77**	T	**64**	6
Potassium	µg/L	-	-	410	3,380	600	1,400	900	1,300	1,300	780	1,760	454
Selenium	µg/L	-	50	<1.5	<1.5	1.6	<1.5	<1.5	<1.5	<1.5	NA	<1	<1.5
Sodium	µg/L	200,000	-	13,600	7,840	20,600	5,120	3,960	10,700	45,100	4,020	30,000	15,600
Thallium	µg/L	-	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Uranium	µg/L	-	20	4.9	<0.5	1.3	3.8	1	5	1.3	NA	NA	NA
Zinc	µg/L	5,000	-	22	<5	9	7	7	8	18	T	12	130

Notes

A. Health Canada Federal-Provincial-Territorial Committee on Drinking Water Guidelines for Canadian Drinking Water Quality (GCDWQ) - Summary Tables (2022) (https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/water-quality/guidelines-canadian-drinking-water-quality-summary-table.html#t2)
B. Aestheic Object (AO) - guideline based on aesthetic considerations such as taste, odour, and staining of applicances
C. Maximum Allowable Concentration (MAC) - health based guideline
D. The GCDWQ (2022) does not have a specific guideline for nitrate + nitrite (as N); however, the associated nitrate (as N) guideline is 10 mg/L.

-	denotes not applicable or guideline not established	µg/L	denotes micrograms per litre
AB	denotes absent	µS/cm	denotes microsiemens per centimetre
NA	denotes parameter not analyzed	EPM	denotes equivalents per million
PR	denotes present	mg/L	denotes milligrams per litre
T	denotes trace, value is below limit of quantitation	NTU	denotes Nephelometric Turbidity Unit
20	**BOLD**/shaded value denotes concentration exceed the GCDWQ AO		
20	**BOLD**/shaded value denotes concentration exceed the GCDWQ MAC		

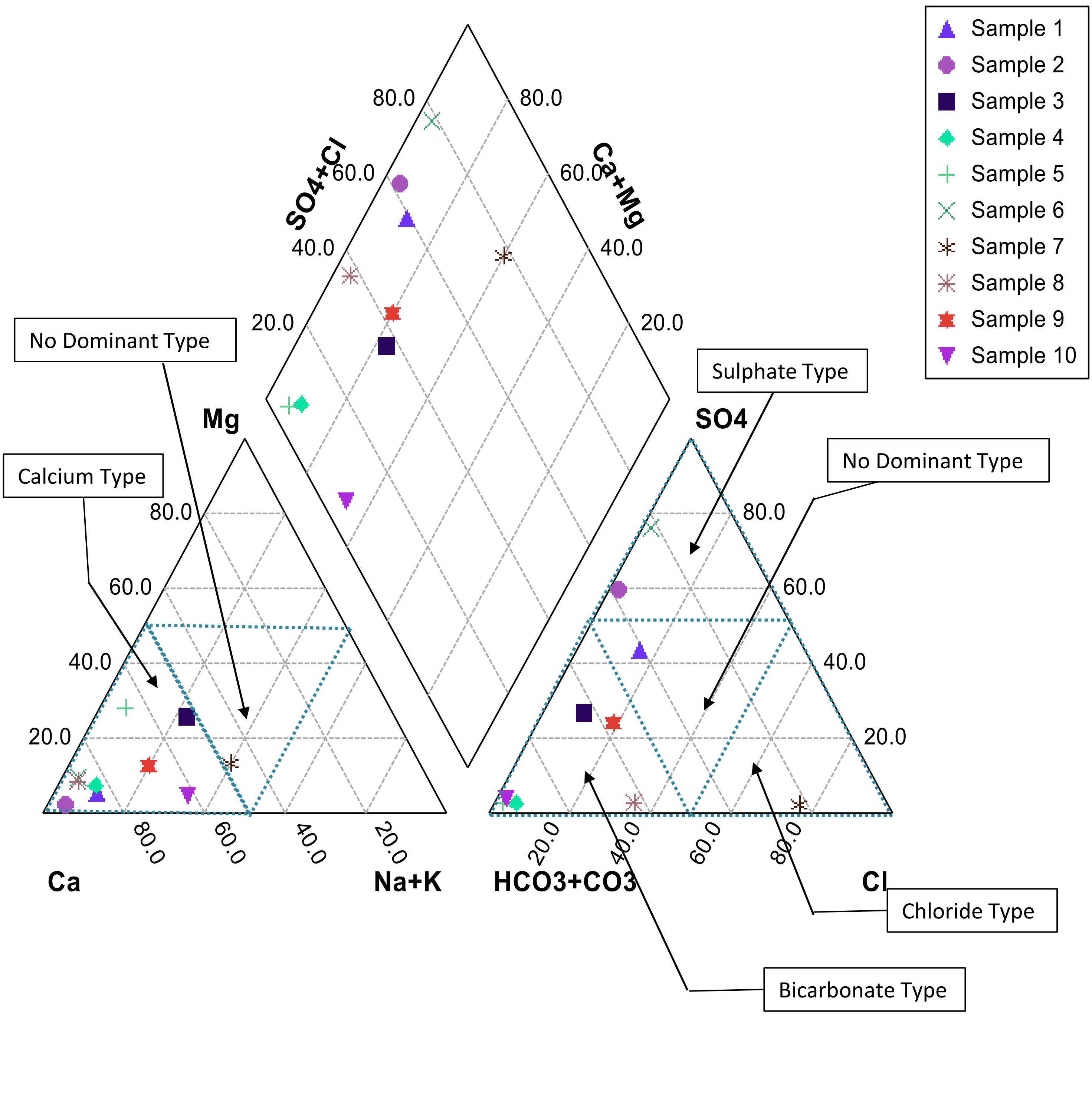


Figure 5.3.3: Groundwater Chemisty Trilinear Piper Plot

PROJECT:	Glenvale Gypsum Quarry		PROJECT NO:	22-4280
CLIENT:	J D Irving Limited	DATE:		August 2022

5.3.3 Environmental Effects Assessment

The environmental effects of the Project on water resources are assessed in this section.

5.3.3.1 Potential Effects

The Project may interact with water resources in the following ways:

- Surface drainage patterns will be altered with the reshaping of the Project site during construction and from the creation of the open pit quarry, and wetlands and unnamed streams are likely to be affected. These effects are expected to begin during construction and continue throughout operation and into reclamation and closure until such time as the open pit fills with water at the end of quarry life.
- The ongoing presence of the open pit during operation and into closure could result in groundwater seepage from surrounding bedrock to drain into the open pit, requiring periodic dewatering and management and potentially changing groundwater availability and/or quality on a localized basis throughout the life of the Project (until the open pit is filled with water at closure).
- Localized water balance may be disrupted through groundwater flow redirection towards the open pit rather than towards the North River. Localized groundwater flow change is not anticipated to cause negative water quality or quantity issues within the LAA and regional groundwater flow in the area is expected to remain unchanged.
- Although groundwater flow is unlikely to have potential effects, there is a potential for Project-related activities to affect localized groundwater quality and quantity due to the presence of the open pit, within which groundwater is expected to seep.
- Blasting will be the primary method for extracting the deposit. Blasting has the potential to cause damage and increased turbidity in potable wells as a result of vibration in the ground.
- Water quality could be affected by accidental spills of lubricants, fuels, or residual chemical effects from blasting (assessed in **Section 7.0**).
- Many of the unmapped wetlands on the site will either be reduced in size or result in a direct loss during the construction and operation phases of the Project. The environmental effects assessment for vegetation and wetlands is provided in **Section 5.5.2**.

It should be noted that acid rock drainage can occur when sulphide-rich minerals are exposed to water and oxygen, resulting in a chemical reaction that releases sulphuric acid and metal oxides. However, not all sulphur-containing minerals generate acid under these conditions. Calcium-sulphate minerals, such as gypsum and anhydrite, are chemically and compositionally stable when exposed to water and oxygen. Therefore, acid rock drainage (and associated metal leaching) is not considered to be a potential concern for this Project.

5.3.3.2 Mitigation

Mitigation is identified for each interaction and/or effect in relation to water resources in an attempt to prevent the interaction from occurring if possible, or to reduce the severity, magnitude, geographic extent, frequency, or duration of the interaction. Best management practices (based on industry guidelines and regulatory guidance documents) have been identified as appropriate mitigative strategies. In addition, several acts, codes, regulations and guidelines may require appropriate actions be conducted as mitigative measures prior to or during the interaction.

The following mitigations will be implemented as a part of the Project:

- Where possible, avoid construction within 30 m of watercourses or wetlands.
- The area of disturbance associated with the development of the physical components of the proposed project will be minimized to the extent possible to limit the associated environmental effects associated with such disturbance.
- Proper erosion and sediment control measures will be installed and checked regularly and prior to and after storm events to confirm they are continuing to operate properly to minimize potential effects to adjacent habitat.
- Exposed soils will be stabilized as soon as practical to minimize emissions of particulate matter, erosion, and the release of sediment-laden runoff.
- Wetlands and unnamed tributaries that are affected as a result of the construction of the open pit mine will be compensated for under the New Brunswick *Clean Water Act* and New Brunswick Wetlands Conservation Policy (NBDNRE-NBDELG 2002). Further information on potential effects to wetlands is provided in **Section 5.5**.
- An Environmental Protection Plan (EPP) will be put in place to establish procedures to minimize the potential for spills or uncontrolled releases. As part of the EPP, spill response measures will be put in place to address unplanned Project-related releases. Project-related accidents, malfunctions, and unplanned events are assessed in **Section 7.0**.
- A baseline water quality survey will be completed for wells (subject to landowner permission) within a 2 km radius of the centre of the Project site, regardless of whether or not they are registered in the OWLS database, prior to the commencement of development activities. Wells within 2 km that are located to the east of the North River are considered hydrogeologically separate from the groundwater associated with the Project and are classified as outside the LAA; therefore, these wells will not be included in the baseline sampling program. Samples will be analyzed for general chemistry (including turbidity), microbiological parameters, and trace metals to establish baseline water quality data. These results will be tabulated and compared to the Canadian Drinking Water Quality Guidelines (Health Canada 2022) prior to the beginning of construction.

- In the unlikely event that a potable well experiences quantity or quality issues during operation and becomes unusable, steps will be taken to provide an alternate water supply. This is usually done through the drilling of a new potable well, providing bottled water, or other means.
- Four shallow monitoring wells and four deep bedrock wells will be drilled in the LAA to establish baseline conditions on the site and to monitor changes in the water level, over time. Water levels will be monitored through the use of pressure transducers (data loggers) that can be programmed to record water levels at set time intervals, or by taking manual water level readings at set time intervals, during construction and operation of the Project. A groundwater monitoring plan will be developed as part of the permitting phase of the Project.
- Commercial explosives contain ammonium nitrate, which if not managed properly, can leach into groundwater. Historically ammonium nitrate/fuel oil (ANFO) is the most common bulk blasting agent used in quarries, and case studies have identified the potential for uncontrolled losses of ANFO to cause elevated levels of ammonia and nitrate in groundwater. For this reason, ANFO will not be used for blasting at this site. Instead, specialized emulsions that are designed by the manufacturers to be more impervious to water leaching will be selected, in consultation with the licensed blasting contractor. As a result of the approach chosen, groundwater contamination due to blasting residues is considered unlikely.

5.3.3.3 Characterization of Residual Effects

From the beginning of construction, surface water contained within wetlands and unnamed watercourses located within the PDA and LAA will be drained and may not return to current conditions with the completion of the Project. This potential residual effect is expected to be limited to the PDA, and the watercourses that extend from the PDA into the LAA. At the end of the quarry's operational life, the open pit will, over time, partially fill with water and become a small lake, as groundwater levels equilibrate. These effects are not expected to reach the main branch of the North River due to the following factors:

- The PDA and LAA comprise a small portion (i.e., 0.85 km^2) of the North River watershed area (i.e., 264 km^2);
- Following the creation of the open pit, surface water and groundwater will continue to discharge to the North River;
- Current conditions on-site include a limited tree canopy due to the former forest harvesting activities; therefore, it is anticipated that surface water temperature conditions (i.e., baseline conditions) are generally warmer; and,
- The groundwater that fills the open pit is expected to provide cooling of the surface water that drains into the open pit; therefore, water discharging from the pit may be cooler than current baseline surface water temperatures.

Groundwater draining into the open pit will be stored in a sump located in the deepest portion of the open pit, and periodically pumped back to surface and release to receiving waters when total suspended sediments meet discharge standards (i.e., a target total suspended sediments [TSS] concentration of less than 25 mg/L above background levels of the receiving waters, measured as a monthly average of grab samples, or as specified in the facility's Approval to Operate to be issued under the *Water Quality Regulation*). If the target TSS concentration cannot be met, pumped water will be held in the settling pond to further allow for suspended solids to settle out of the water before being discharged to the natural environment. Water quality will be monitored throughout the operation phase to confirm the quality of water being discharged to the environment meets the applicable discharge criteria, and that the rate of release is such that discharged water does not overwhelm the capacity of the receiving watercourse.

Residents within the LAA will be offered to participate in the baseline sampling program to establish baseline water quality data (subject to landowner permission). These results be tabulated and compared to the Canadian Drinking Water Quality Guidelines (Health Canada 2022) prior to the beginning of construction. In the unlikely event that a potable well experiences water quantity or quality issues during operation and/or becomes unusable, steps will be taken to provide an alternate water supply. This is usually done through the drilling of a new potable well, providing bottled water, or other means.

Four shallow monitoring wells and four deep bedrock wells will be drilled in the LAA to establish baseline conditions on the site and to monitor changes in the water level over time. Water levels will be monitored through the use of pressure transducers (data loggers) that can be programed to record water levels at set time intervals, or by taking manual water level readings at set time intervals during the Project.

5.3.4 Summary

Based on the above, with planned mitigation and environmental protection measures, the residual environmental effects of the Project on water resources during each phase of the Project are rated not significant, with a moderate level of confidence.

Monitoring programs to be implemented, including a residential water well sampling program, routine monitoring of discharge water quality, and water level and quality of perimeter monitoring wells throughout the Project life, with associated adaptive management as required, will improve the level of confidence of this prediction. Details of monitoring will be provided in the EPP and groundwater monitoring plan.

5.4 Fish and Fish Habitat

The potential environmental effects of the Project on fish and fish habitat are assessed in this section.

5.4.1 Scope of VC

Fish and fish habitat includes aquatic life (such as fish and benthic macro-invertebrate species/populations) and the habitat that supports them, including mapped and unmapped (field identified) watercourses. Fish and fish habitat are considered a valued component (VC) of the environment because of their importance in supporting freshwater aquatic life as a fisheries resource for humans, as food source for other wildlife, and in providing recreational opportunities, which are of importance to the public, stakeholders, and Indigenous communities.

Fish and fish habitat was selected as a VC due to the possible environmental effects of:

- A potential change or alteration of, disruption to, or removal of aquatic (including fish) habitat as a result of the Project; and,
- Effects to aquatic species listed under the federal *Species at Risk Act* (SARA) and/or the New Brunswick *Species at Risk Act* (NB SARA).

In addition, fish and fish habitat are protected through the federal *Fisheries Act* as well as the New Brunswick *Fish and Wildlife Act* and the *Watercourse and Wetland Alteration Regulation* under the New Brunswick *Clean Water Act*. The federal *Fisheries Act* provides protection for all fish and fish habitat (DFO 2019). Section 35(1) of the *Fisheries Act* prohibits the harmful alteration, disruption or destruction (HADD) of fish habitat; Section 34.4(1) prohibits the death of fish by means other than fishing; and Section 36(3) prohibits the release of a deleterious substance into waters frequented by fish. Additionally, aquatic species at risk are protected under both the federal and provincial *Species at Risk Act.*

The Project has the potential to affect fish and fish habitat through changes in hydrology, water quality and quantity, productivity, and loss of fish habitat.

5.4.1.1 Temporal Boundaries

The temporal boundaries for the Project include the following:

- **Construction**: extending for a period of approximately four months, anticipated to begin in the fourth quarter (Fall) of 2023 (subject to the receipt of all approvals and permits required for the Project);
- **Operation**: beginning in approximately the first quarter of 2024, and lasting for approximately 10 years or until the mineral resource has been depleted; and,
- **Reclamation and closure**: to be initiated following the completion of operations at the site, with decommissioning and reclamation of the surface facilities at the site for an anticipated duration of six months following operation.

5.4.1.2 Spatial Boundaries

The Project development area (PDA) is defined as the area of physical disturbance associated with construction and operation of the Project. Specifically, the PDA consists of an area of approximately 85 ha (i.e., conservatively assumed to be the entirety of PIDs 00814160, 70076948, and 70654058) that includes the open pit and all related surface facilities located on the property. The PDA is the area represented by the physical Project footprint.

The local assessment area (LAA) is the maximum anticipated area within which Project-related environmental effects are expected. For fish and fish habitat, the LAA includes the aquatic habitats within the PDA, as well as within a 500 m radius around the PDA that includes tributaries to the North River and watercourses that extend off of the property and interconnect with tributaries of the North River, including a 30 m buffer around such watercourses.

5.4.1.3 Significance Threshold

A significant adverse residual environmental effect on fish and fish habitat is defined as one that results in an unmitigated, unauthorized, or non-offset loss of fish habitat that results in the harmful alteration, disruption, or destruction (HADD) of fish habitat, as defined under the *Fisheries Act*. For fish populations, a significant adverse residual environmental effect would result from a Project-related unauthorized death of fish by means other than fishing as defined under the *Fisheries Act* or the destruction of fish resulting in a decline of regional fish populations that was not authorized under the *Fisheries Act*.

Such an environmental effect may alter the aquatic environment physically, chemically, or biologically, in quality or extent, that could include, for example, exceeding long-term Canadian Council of Ministers of the Environment (CCME) guidelines for the Protection of Freshwater Aquatic Life (CCME 1999), or from an unapproved Project-related alteration of water quality that would constitute water pollution as defined in the New Brunswick *Clean Environment Act*.

5.4.2 Existing Conditions

The information regarding the presence and characterization of fish and fish habitat within the PDA and LAA was derived from several sources including existing databases and secondary information sources (i.e., desktop analysis), as well as field assessment.

5.4.2.1 Regional Setting

The Project is located in Westmorland County in southeastern New Brunswick within the Petitcodiac watershed, which drains into the Shepody Bay which in turns flows into the eastern portion of the Bay of Fundy. The Petitcodiac River has a total drainage area of approximately 2,831 km^2 (NBDELG 2007). The mapped watercourses (as mapped on the GeoNB website) that intersect with the PDA include the reaches of three small unnamed tributaries to the North River, which are associated a with wetland feature just downstream of the PDA (refer to **Figure 5.3.1**).

Fish species that typically reside in the Petitcodiac River include: American eel (*Anguilla rostrata*), American shad (*Alosa sapidissima*), Atlantic salmon (*Salmo salar*), Atlantic tomcod (*Microgadus tomcod*), blueback herring (*Alosa aestivalis*), alewife (*Alosa pseudoharengus*), brook trout (*Salvelinus fontinalis*), brown bullhead (*Ameiurus nebulosus*), chain pickerel (*Esox niger*), rainbow smelt (*Osmerus mordax*), smallmouth bass (*Micropterus dolomieu*), striped bass (*Morone saxatilis*), white perch (*Morone americana*), and white sucker (*Acipenser brevirostrum*) (NBDELG 2007). The Petitcodiac River maintains an annual run of returning adult Atlantic salmon (inner Bay of Fundy population) (FFHR 2017). The inner Bay of Fundy population of Atlantic salmon is in decline and has been listed as "Endangered" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and under the federal *Species at Risk Act* (SARA).

5.4.2.2 Desktop Analysis

Prior to completing the fish and fish habitat field assessments, Dillon reviewed readily available information from reputable sources. The information was reviewed to evaluate the potential for aquatic species of conservation concern (SOCC) and/or aquatic species at risk (SAR) within the general area of the Project and to assist in scoping the field programs. The information was reviewed, along with information on aquatic habitats and wetlands present in the general area. Dillon completed a review of the following sources and data lists prior to completing the field assessments:

- Atlantic Canada Conservation Data Centre (AC CDC);
- Department of Fisheries and Oceans (DFO);
- New Brunswick Department of Natural Resources and Energy Development (NBDNRED);
- New Brunswick Department of the Environment and Local Government (NBDELG);
- The federal Species at Risk Registry;
- The provincial Species at Risk Registry;
- The Committee on the Status of Endangered Wildlife in Canada (COSEWIC);
- Publicly-available GIS map layers (e.g., ecological land classification, forest and non-forest inventory, draft beta wetland mapping inventory, Protected Natural Areas, and Wildlife Management Zones);
- High resolution aerial photography; and,
- GeoNB wetland and watercourse mapping.

In this report, we define "species at risk" (abbreviated SAR) as those species that are listed as "Extirpated", "Endangered", "Threatened", or "Special Concern" on Schedule 1 of the federal *Species at Risk Act* (SARA) or the New Brunswick *Species at Risk Act* (NB SARA). We also define "species of conservation concern" (abbreviated SOCC) as those species that are not SAR but are listed in other parts of SARA, NB SARA, COSEWIC, or as regionally rare or endangered by the AC CDC (i.e., those species with AC CDC S-ranks of "extremely rare" [S1], "rare" [S2] or "uncommon" [S3]).

A custom Atlantic Canada Conservation Data Centre (AC CDC) (2022) data report (refer to **Appendix A**) was obtained for a 5 km radius around the PDA. According to the AC CDC records review, there is one record of aquatic SAR that has been historically observed within 5 km of the Project: the brook floater (*Alasmidonta varicosa*) is ranked as S3 (Vulnerable) by the AC CDC and is also listed as Special Concern by COSEWIC, SARA and NB SARA. In addition, the DFO aquatic species at risk mapping (DFO 2022) identified Atlantic salmon (*Salmo salar*) (listed as Endangered under Schedule 1 of SARA) as potentially occurring within the tributary to North River that crosses the PDA.

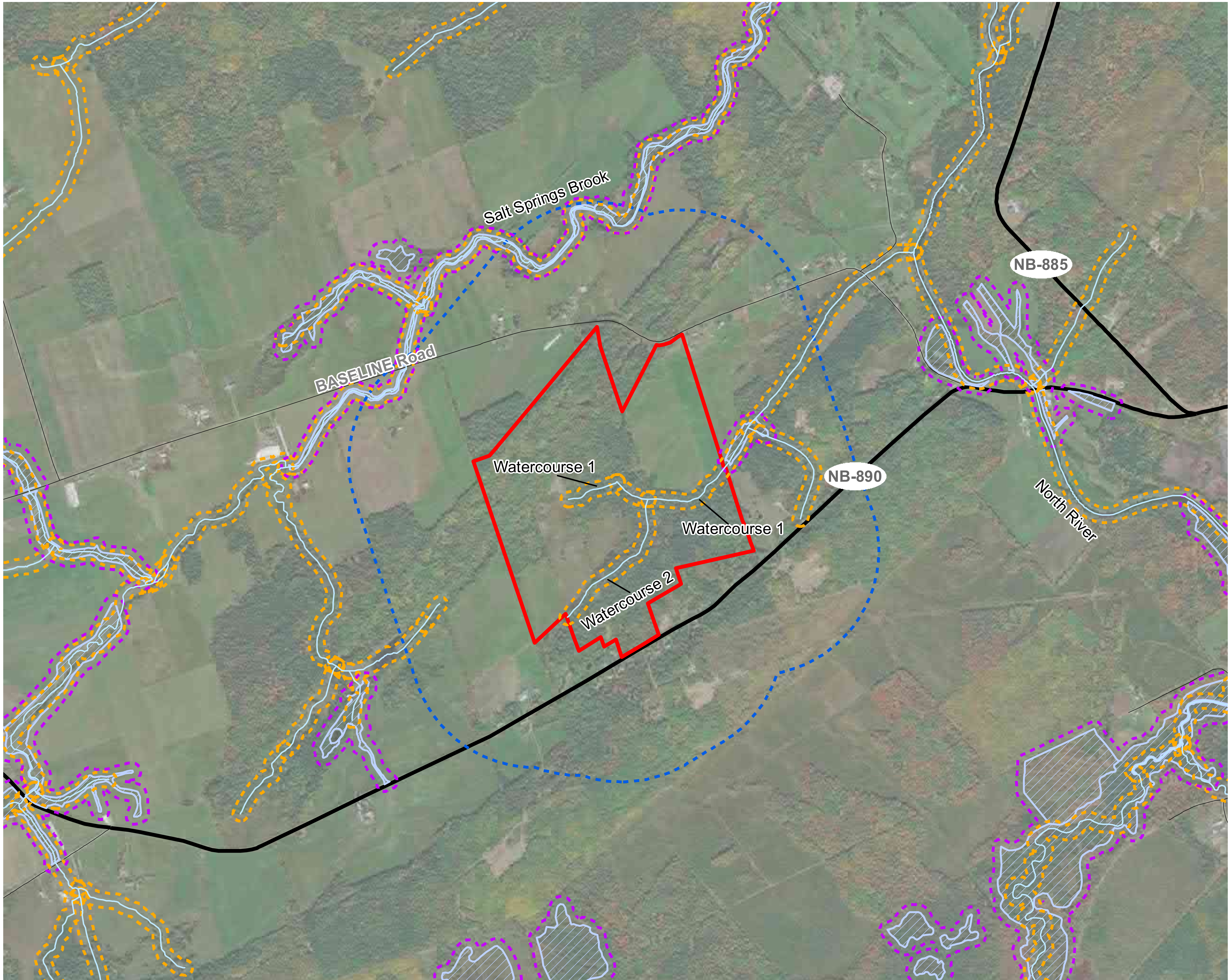
The Petitcodiac Watershed Alliance (PWA) has collected water quality data for the Petitcodiac River over several years. The Fort Folly Habitat Recovery (FFHR) is a membership-based group that has engaged in many Atlantic salmon habitat and population enhancement programs since its inception including: fish stocking programs, population and spawning assessments, habitat restoration, and community outreach and education (FFHR 2017). Given that the Petitcodiac River is located more than 3 km from the PDA and will not be directly affected by the Project, a field survey of the Petitcodiac River or the North River was not considered to be required. It is noted that substantial historical data for the Petitcodiac River are available from the PWA and FFHR.

Additionally, there are two managed areas, the Hillgrove Karst ESA and the Mannhurst-kinnear Settlement Roadside ESA, within 5 km of the PDA. There were no other biologically significant, or designated Environmentally Significant Areas (ESA) or Protected Natural Areas (PNA) containing significant or unique aquatic habitats, identified within 5 km of the PDA.

The GeoNB watercourse mapping (1:10,000) database identified three small mapped watercourses that intersect the PDA (**Figure 5.3.1**). Note, these small unnamed tributaries to the North River drain into a mapped wetland feature just outside the PDA.

5.4.2.3 Field Assessment

A field assessment of fish and fish habitat in the PDA was conducted on July 18-21, 2022 by Dillon biologists experienced in conducting aquatic/fish habitat surveys. A First Nations member worked with Dillon's biologists during the field surveys to provide some traditional knowledge perspective. During the assessment, two watercourses (identified as Watercourse 1 [WC1] and Watercourse 2 [WC2]) were identified (refer to **Figure 5.4.1**). Note, the GeoNB mapped watercourse shown in **Figure 5.3.1** from the pond in the northern portion of the PDA connecting to WC1 could not be identified in the field; therefore, for the purpose of this EIA Registration, this watercourse does not exist. The detailed methods and results for fish and fish habitat assessments of WC1 and WC2 are summarized in the following sections.



HAMMOND RIVER HOLDINGS LIMITED
PROPOSED GLENVALE GYPSUM QUARRY

FISH HABITAT IN THE LOCAL ASSESSMENT AREA
FIGURE 5.4.1

- Highway
- Road
- Watercourses
- Project Development Area
- Project Development Area 500 m Buffer
- Watercourse 30 m Buffer
- Wetland 30 m Buffer
- Wetland (NBDELG 2021)

0 100 200 400 Meters

SCALE 1:15,000

N W E S

MAP DRAWING INFORMATION:
DATA PROVIDED BY DILLON CONSULTING LIMITED, CANVEC
SERVICE LAYER CREDITS: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), SWISS TOPO, OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

MAP CREATED BY: RP
MAP CHECKED BY: JO
MAP PROJECTION: NAD_1983_CSRS_NEW_BRUNSWICK_STEREOGRAPHIC

DILLON CONSULTING

PROJECT: 22-4280
STATUS: FINAL
DATE: 2022-09-22

FILE LOCATION: K:\2022\224280\Product\Client\Glenvale\Figure5.4.1 Fish Habitat in the Local Assessment Area.mxd

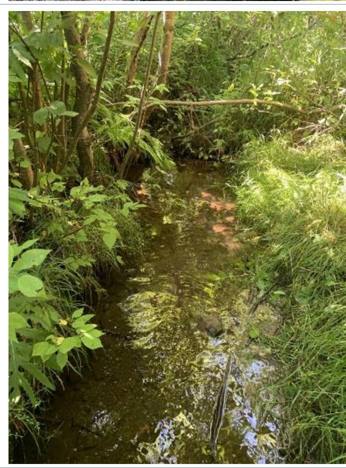
Fish Habitat Assessment

The aquatic habitat assessment was conducted using sampling protocol based on the NBDNRED (formerly Department of Natural Resources [NBDNR]) and DFO standard aquatic assessment forms (Hooper et al. 1995) and the NBDNR Provincial Brook Trout Assessment Outline (NBDNR 2010). Fish habitat and aquatic features were assessed on mapped and field-identified watercourses within the PDA. The assessment criteria included:

- **Description of aquatic habitat type:** Habitat types within each watercourse was described as riffle, run, pool or flat, where possible;
- **Dominant substrate type and embeddedness:** Dominant substrate types were described and documented by percent of relative abundance. Substrate type (e.g., gravel or silt) is especially important for fish spawning habitat;
- **Stream channel characteristics:** Stream channel characteristics including average wet width, approximate bankfull width, average wetted depth, and maximum wetted depth were measured in the field;
- **Instream cover and overhead canopy cover ratings:** Instream cover such as submerged woody debris, cobble, boulders, aquatic vegetation was documented, and overhead canopy cover ratings (percent covered by shrubs and trees) were scored;
- **Fish habitat suitability:** Habitat suitability for fish is assessed (based on the evaluation of habitat type, substrate type, instream cover, overhead cover and general observations of fish in the area);
- **Environmental Conditions and Water Level:** Environmental conditions (e.g., drier than normal seasonal conditions) were noted during the assessment and water level was rated as “low, moderate or high”. Hotter and drier environmental conditions resulting in lower water levels will stress salmonid fish populations;
- **Riparian vegetation community:** The riparian vegetation community was described by percent trees, shrubs, grasses and bare ground; and,
- **Representative photos** (provided in **Table 5.4.1**) and Geographic Positioning System (GPS) points (using a handheld GPS unit and Arc Geographic Information Systems (ArcGIS) applications) were collected for each watercourse during the field assessments.

During the field assessment of fish and fish habitat conducted within the PDA, two mapped watercourses (WC1 and WC2) were identified. The results of the fish and fish habitat assessments are presented in the following sections and summarized in **Table 5.4.1**, below. For further details on the wetlands located within the PDA, refer to **Section 5.5**.

Table 5.4.1: Summary of Watercourse Characteristics

Watercourse ID	Representative Photo	Average Stream Dimensions (m)	Dominant Aquatic Habitat Type and Other Observations
Watercourse 1 (WC1) – Unnamed (Mapped) Tributary to North River		Wet Width: 1.60 m Bankfull Width: 1.60 m Average Depth: 0.09 m	Intermittent watercourse, with predominantly flat and some riffle/pool habitat. Fish were observed during the field survey. **Dominant Substrate:** 10% Cobble, 10% Gravel, 80% Fines (<2mm)
Watercourse 2 (WC2) – Unnamed (Mapped) Tributary to North River		Wet Width: 1.33 m Bankfull Width: 1.63 m Average Depth: 0.06 m	Intermittent watercourse, with predominantly flat and some riffle/pool habitat. Fish were observed during the field survey. **Dominant Substrate:** 10% Gravel, 90% Fines (<2mm)

Unnamed Tributary to North River – Watercourse 1 (WC1) – WC1 is a mapped watercourse determined to be a small intermittent fish-bearing stream during the field survey, which originates in the centre of the PDA in a treed swamp wetland (WL1). Refer to **Section 5.5** for more information on the field delineated wetlands. The watercourse originates in a disturbed wetland (open field area) near the center of the PDA. The downstream reaches (the majority of the watercourse) consist of run/pool habitat in softwood dominant forest. The overall crown closure for the watercourse across all reaches was around 50%, with on average a moderate amount of large woody debris which provides instream cover for fish. The substrate in the upper reaches consisted of mostly fines, sand and small amounts of gravel. With increasing amounts of cobble and gravel in downstream reaches. WC1 was also identified as being a drainage feature for WL1 – see **Section 5.5**. Fish (minnows) were observed during the assessment.

Unnamed Tributary to North River – Watercourse 2 (WC2) – WC2 is a mapped watercourse located in the southern portion of the PDA which was characterized during the field survey as a small intermittent fish-bearing stream during the field survey and a wetland drainage of field-identified wetland WL2. The watercourse flows northeast from the southwest corner of the PDA for approximately 600 m where it meets WC1. Similar to WC1, the crown closure for WC2 is around 50%. However, WC2 contained less amounts of large wood debris, trace amounts as opposed to moderate for WC1.

Fish Presence Assessment

Qualitative fish presence assessments using backpack electrofishing techniques were conducted in the watercourses within the PDA where potential fish habitat was present. Assessment methods were designed to collect a representative sample of the fish community by distributing assessment efforts between habitat types (i.e., riffle, pool, and undercut banks) within the assessed reach. A backpack electrofishing unit (Halltech HT2000) equipped with an 11-inch anode ring was used for the fish surveys, with two (2) technicians to recover the fish using with dip nets. Unit settings ranged from 100 to 150 V and a frequency of 40 Hz, depending on the conductivity of the watercourse and observed fish response. Fish presence surveys were completed on both WC1 and WC2 on July 20 and 21, 2022.

Based on the qualitative electrofishing surveys, the only fish species captured in WC1 and WC2 was brook trout (*Salvelinus fontinalis*), which are generally considered cooler (“cold”) water species, and prefer water with a higher dissolved oxygen (DO) level (associated with cooler water) when compared to slower moving and warmer bodies of water (CRI 2011). It should be noted that other minnow species were visually observed during the field surveys.

There were no SOCC or SAR species observed during the field observations.

Water Quality Sampling and Analysis

Measurements of water quality parameters using a YSI Pro Plus water quality meter were obtained in WC1 and WC2 located within the PDA. In-situ measurements were recorded for water temperature (°C), conductivity (µS/cm), dissolved oxygen (DO) (mg/L and %), total dissolved solids (TDS), and pH.

The CCME has established environmental quality guidelines for contaminant concentrations in various environmental media, as established in its Canadian Environmental Quality Guidelines (CEQG) for the protection of freshwater aquatic life (FWAL) (CCME 1999). Relevant to aquatic life, the CEQGs for FWAL were used for comparison for laboratory water quality results.

The field measurements for water quality of WC1 and WC2 are presented in **Table 5.4.2**. Based on the results of water quality measurements collected in WC1 and WC2, there were exceedances of the CCME FWAL guideline for dissolved oxygen levels for early life stage cold water species. High conductivity levels were observed at the time of the field survey (refer to **Table 5.4.2**), which can likely be attributed to local bedrock formations that contain evaporites. Both watercourses had relatively cool temperatures, given the time of year during which the measurements were taken, especially in these slow-flowing first order tributaries. Low temperatures observed in both watercourses denotes that the water quality is suitable for both cold water fish species and tolerant species observed during the surveys (NBDELG 2012). The low DO values were below the CCME FWAL (early life stages require a minimum DO of 9.5 mg/L) (CCME 1999), however, these conditions are typical in New Brunswick streams that contain abundant fish and diverse fish populations. It should be noted that water levels were low at the time of the surveys and dry, hot conditions were experienced throughout the region.

Table 5.4.2: Summary of In-situ and Laboratory Water Quality Results

Parameter	Units	CCME FWAL [1] (Long-Term)	Sample ID	
			Watercourse 1 (WC1)	Watercourse 2 (WC2)
In-situ water quality measurements				
Temperature	°C	NA	14.9	14.7
pH	-	6.5 - 9.0	7.91	7.83
Specific Conductivity	µS/cm	NA	884	983
Total dissolved solids (TDS)	mg/L	NA	572	637
Dissolved oxygen (DO)	mg/L	>9.5	7.19	7.85
Dissolved oxygen (DO)	%	NA	71.4	76.35

[1] CCME (1999)

NA indicates not available.

5.4.3 Environmental Effects Assessment

The environmental effects of the Project on fish and fish habitat are assessed in this section.

5.4.3.1 Potential Effects

Without mitigation, the Project could interact with fish and fish habitat in the following ways:

- Construction activities have the potential to result in the direct loss of fish habitat in areas to be occupied by the open pit or other surface facilities and related flow diversions, with potential for direct mortality of fish in those affected watercourse segments;
- Construction and operation could also result in the indirect loss of fish habitat in areas where the presence of Project-related facilities cause a change in surface water availability (e.g., draining into the open pit), with potential for direct mortality of fish in those watercourse segments;
- Construction in the areas of the watercourses will require removal of surface materials including vegetation and soils (i.e., topsoil and overburden) above the gypsum deposit. This could increase erosion rates or alter natural drainage patterns in proximity to the aquatic receptors;
- Storage of site runoff in the pit sump or settling ponds during operation may result in a change in surface water hydrology and a change in surface water levels in receiving waters from sequestering water in these features;

- Release of surface water that could result in a change in water quality in the receiving environment;
- Loss of wetland area or function(s) (such as hydrological regime, habitat and water quality maintenance) could occur due to clearing of trees and vegetation within the wetland watershed which may affect the quality and quantity of water to watercourses; and,
- A spill or fire could occur as an accident or unplanned event which could affect water quality and fish habitat.

5.4.3.2 Mitigation

The following standard mitigation measures have been identified to reduce the likelihood of occurrence, or minimize potential extent of effects of the Project on fish and fish habitat. Planned standard mitigation measures for the proposed project include the following:

- The area to be disturbed by the Project will be minimized to the extent possible to only that area which is required to accomplish the Project objectives;
- Design surface water drainage to minimize changes in drainage;
- Potential installation and/or upgrades to watercourse crossings (culverts) will be designed as per the New Brunswick Watercourse and Wetland Alteration (WAWA) Guidelines (NBDELG 2012);
- Maintaining a 30 m buffer around watercourses and wetlands, or if not possible, obtaining a watercourse and wetland alteration (WAWA) permit for alterations of watercourses and their 30 m buffers;
- Applying for an authorization under Section 35(2) of the *Fisheries Act* for Project activities that would result in the loss of fish habitat or other activities that result in a harmful alteration, disruption, or destruction (HADD) of fish habitat (as determined by DFO), with appropriate offsetting;
- Construction and operation activities will comply with the conditions of the WAWA permit and *Fisheries Act* authorization;
- Efforts will be made to maintain as much mature vegetation that remains along the edges of the site as possible, so as to act as a tree and watercourse buffer; in particular, existing treed buffers surrounding watercourses located on the PDA will be maintained to the extent possible;
- In watercourses where direct loss of fish habitat may occur, a fish rescue program will be implemented prior to undertaking construction activities, and fish will be removed and relocated as per DFO guidance and consultation;
- Implement a water management plan that incorporates measures aimed at retaining site water in a pit sump and settling pond to allow for settling of suspended sediments prior to release to the environment;

- Minimize the project activities to exclude mineral processing
- Monitor surface water released from the Project site to confirm that mitigation measures are maintaining the total suspended sediment (TSS) in site runoff at concentration less than 25 mg/L above background levels measured at the confluence of the receiving watercourse and a pH of between 6.5 and 9.0, as a monthly average of grab samples. No additional testing is warranted given the nature of the gypsum resource itself is an inert, chemically stable, pH neutral, non-reactive material that does not cause acid or alkali generation and thus does not result in metal leaching.;
- Implement requirements and limitations for blasting as outlined in the DFO *Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters* (Wright and Hopky 1998);
- Proper erosion and sediment control measures will be installed and checked regularly and prior to and after storm events to confirm they are continuing to operate properly to minimize potential effects to adjacent habitat; and,
- An emergency response plan (ERP) for accidental spills, emergencies, incidents or storm events will be completed and detailed in the Environmental Protection Plan (EPP), and the contractor will be required to provide spill response training to construction personnel.

5.4.3.3 Characterization of Residual Effects

The Project will result in the direct loss of the upper stretches of watercourse 1 (WC1) and the lower reaches of watercourse 2 (WC2) that intersect the PDA, to allow for the construction of the stockpile and settling pond areas. This is an unavoidable loss to accomplish the Project, which will occur during construction and persist through the life of the Project. The Project has been developed to minimize the area of disturbance of the PDA to that which is required to meet the Project objectives, maintaining treed buffers around wetlands and watercourses where possible, to minimize the extent of fish habitat loss. Note that although there is a third mapped watercourse on the GeoNB map viewer that appears to be associated with a wetland feature within the PDA, field biologists did not encounter evidence of a waterbody at this location in the field during the fish and fish habitat surveys completed in July 2022; as such, this potential third watercourse is not discussed further.

During operation, it is anticipated that additional indirect loss of, or alterations to watercourses could occur from localized changes in surface water hydrology arising from the reshaping of the Project site and the storage of runoff in the settling pond. The localized changes to drainage patterns occurring on or adjacent to the PDA are expected to be small in magnitude (given the small size of WC1 and WC2), and given that the North River is located more than 1 km from the nearest portion of the PDA, potential environmental effects to the North River itself are not expected.

The direct and indirect loss of fish habitat that is deemed by DFO to result in a harmful alteration, disruption, or destruction (HADD) of fish habitat will be authorized under Section 35(2) of the *Fisheries Act* (with appropriate offsetting) prior to beginning the Project. Additionally, a WAWA permit will be obtained for alterations to, or loss of, watercourses or their 30 m buffers.

Without mitigation, construction activities and some operation activities (e.g., blasting) could result in injury or direct mortality of fish in nearby watercourses. The implementation of a fish rescue program prior to undertaking construction activities that could affect watercourses, and compliance with the DFO guidelines for the use of explosives near water (Wright and Hopky 1998), will reduce the potential for mortality to occur.

Activities during construction and operation could result in erosion of surficial soils and corresponding sedimentation of surface runoff that, unmitigated, could affect receiving water quality. The Project will be conducted in a manner that minimizes the potential for such effects to occur, including the use of properly designed, sized, and maintained erosion and sedimentation control structures to prevent such releases. These structures will be visually inspected prior to and following major precipitation events and following the spring freshet, and maintained accordingly to confirm their effectiveness. With these measures, and given that gypsum is inert, water quality is not expected to be adversely affected. The potential failure of erosion and sedimentation control devices is assessed as an accident, malfunction, or unplanned event in **Section 7.0**.

Storage of site runoff in the pit sump or settling ponds during operation may result in a localized change in surface water hydrology and a change in surface water levels in receiving waters arising from sequestering water in these features. However, given the large size of the watershed and the limited size of the PDA (with corresponding relatively small amount of water to be sequestered then released in comparison to the amount of water in the Petitcodiac River and watershed), these effects are not expected to be measurable nor to affect fish and fish habitat.

The release of water that does not meet discharge standards, could result in a change in water quality in the receiving environment. The use of the water management features planned for the Project (i.e., pit sump, settling pond, perimeter ditches, and drainage channels) is intended specifically to reduce these potential effects on fish and fish habitat. The release of stored surface water from the Project site will target a total suspended sediment (TSS) concentration of less than 25 mg/L above background levels of the receiving watercourse and a pH of between 6.5 and 9.0, as a monthly average of grab samples, to minimize the environmental effects on water quality in receiving waters.

Other than the small amount of fuel contained in mobile equipment, there are no liquid wastes or hazardous materials planned to be stored on-site. Equipment refuelling will be conducted on a daily basis using fuel trucks that will refuel the equipment, then leave the site. Refuelling will be conducted a minimum of 30 m from a watercourse or wetland. As such, spills are not likely to occur for the Project as planned. Spills or releases of hazardous materials, in the unlikely event that they were to occur, would be an accident, malfunction, or unplanned event, and are assessed in **Section 7.0**.

5.4.4 Summary

In light of the above, and with authorization and offsetting measures as mitigation for direct loss of fish habitat, the relocation of fish from within the PDA, and the implementation of other mitigation measures aimed at reducing or minimizing environmental effects on fish and fish habitat, the residual environmental effects of the Project on fish and fish habitat during each phase are rated not significant, with a moderate level of confidence. The implementation of water management features, water quality monitoring, groundwater level monitoring, and other follow-up and monitoring measures to be implemented to monitor changes to water quality or water levels arising from the Project, with adaptive management measures implemented as necessary to address those changes, will improve the confidence of this prediction.

5.5 Vegetation and Wetlands

The potential environmental effects of the Project on vegetation and wetlands are assessed in this section.

5.5.1 Scope of VC

Wetlands are defined as land where the water table is at, near, or above the land's surface, or land which is saturated for a long enough period to promote wetland or aquatic processes as indicated by hydric soils, hydrophytic vegetation, and various kinds of biological activities adapted to the wet environment (NBDNRE-NBDELG 2002; NTNB 2018). Vegetation is included due to the potential for interactions with rare plants and Project activities, particularly species at risk (SAR) or species of conservation concern (SOCC) as identified as "extremely rare" (S1), "rare" (S2) or "uncommon" (S3), if they are present (AC CDC 2022) and/or pursuant to the federal *Species at Risk Act* (SARA) and the New Brunswick *Species at Risk Act* (NB SARA). Wetlands often support rare or uncommon species assemblages and New Brunswick *Wetlands Conservation Policy* and regulatory processes are guided towards the goal of achieving no net loss of wetland function (NBDNRE-NBDELG 2002).

Vegetation and wetlands were selected as a VC because of their relationship with water resources, wildlife and wildlife habitat, and other biological and physical components addressed as VCs in this EIA Registration. Also, wetlands are widely recognized as providing a host of ecosystem functions and benefits including, but not limited to, filtering out pollutants and heavy metals, mitigating flood events, and providing habitat to many SAR in New Brunswick such as the wood turtle (*Glyptemys insculpta*), Least Bittern (*Ixobrychus exilis*), and Yellow Rail (*Coturnicops noveboracensis*; NTNB 2018). Project activities have the potential to cause adverse environmental effects through the proposed physical destruction of wetland habitat, as well as terrestrial and aquatic vegetation.

New Brunswick's wetlands have been given specific protection pursuant to the New Brunswick *Clean Environment Act* and the *Clean Water Act*. The New Brunswick Department of Environment and Local Government (NBDELG) requires a permit for alterations within 30 m of the banks of a watercourse or regulated wetland.

In this EIA Registration document, we define "species at risk" (SAR) as those species that are listed as "Extirpated", "Endangered", "Threatened", or "Special Concern" on Schedule 1 of the federal *Species at Risk Act* (SARA) or the New Brunswick *Species at Risk Act* (NB SARA). We also define "species of conservation concern" (SOCC) as those species that are not SAR but are listed in other parts of SARA, NB

SARA, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), or as regionally rare or endangered by the Atlantic Canada Conservation Data Centre (AC CDC) (i.e., those species with AC CDC S-ranks of “extremely rare” [S1], “rare” [S2] or “uncommon” [S3]).

5.5.1.1 Temporal Boundaries

The temporal boundaries for the Project include the following:

- **Construction**: extending for a period of approximately four months, anticipated to begin in the fourth quarter (Fall) of 2023 (subject to the receipt of all approvals and permits required for the Project);
- **Operation**: beginning in approximately the first quarter of 2024, and lasting for approximately 10 years or until the mineral resource has been depleted; and,
- **Reclamation and closure**: to be initiated following the completion of operations at the site, with decommissioning and reclamation of the surface facilities at the site for an anticipated duration of six months following operation.

5.5.1.2 Spatial Boundaries

The Project development area (PDA) consists of an area of approximately 85 ha (i.e., conservatively assumed to be the entirety of PIDs 00814160, 70076948, and 70654058) that includes the open pit and all related surface facilities located on the property. The PDA consists of an irregularly-shaped property, with approximate maximum dimensions of 950 m in an east-west direction, by 1,200 m in a north-south direction (refer to **Figure 1.2.1**). The PDA is the area represented by the physical Project footprint.

The local assessment area (LAA) is the maximum anticipated area within which Project-related environmental effects are expected. For vegetation and wetlands, the LAA includes the PDA and nearby wetlands whose catchment areas would include a portion of the PDA. This is due to the potential for altering the wetlands’ hydrological regime as a result of Project-related activities that will occur within the PDA. For vegetation species that rely on wetland habitat, a change in hydrological regime may also result in an adverse effect (i.e., potential stress or loss) of vegetation within the altered wetlands. For upland (terrestrial) vegetation species, the LAA is limited to the PDA (i.e., area to result in loss of vegetation through clearing activities and site development).

5.5.1.3 Significance Threshold

A significant adverse residual environmental effect on wetlands and vegetation is one where Project-related activities result in a net loss of wetland function that cannot be compensated (as per the New Brunswick *Wetlands Conservation Policy*) or the unauthorized loss of vegetation SOCC/SAR that directly affects the sustainability of the population in New Brunswick.

5.5.2 Existing Conditions

The information regarding the presence and characterization of wetlands and the characterization of vegetation communities within the PDA and LAA was derived from several sources including existing databases and secondary information sources (i.e., desktop analysis) as well as field surveys. The methods conducted during the desktop analysis and field surveys are presented below in the following sections.

5.5.2.1 Regional Setting

As stated in **Chapter 3**, the PDA and LAA located within the Eastern Lowlands ecoregion and, more specifically, within the Petitcodiac ecodistrict. The Petitcodiac River dominates the landscape. It begins in the boggy plateau of the Castaway Ecodistrict and flows southwest to the village of Petitcodiac. There, it turns abruptly northeast to parallel the regional bedrock structure until reaching Moncton, where it angles again to pour southward into a river estuary and Shepody Bay (Zelazny 2007).

Red spruce (*Picea rubens*) dominates the forest, together with white spruce (*P. glauca*), black spruce (*P. mariana*), balsam fir (*Abies balsamea*), red maple (*Acer rubrum*), white birch (*Betula papyrifera*), and trembling aspen (*Populus tremuloides*). Other species such as tamarack (*Larix laricina*), white pine (*Pinus strobus*), and hemlock (*Tsuga canadensis*), may be present. Tolerant hardwood stands of sugar maple (*A. saccarum*), beech (*Fagus grandifolia*), and yellow birch (*B. alleghaniensis*) are found on ridgetops or upper slopes, especially over slightly calcareous soils (Zelazny 2007).

5.5.2.2 Desktop Analysis

Prior to completing the field surveys, Dillon reviewed readily available information from reputable sources. The information was reviewed to evaluate the potential for vegetation SOCC and/or vegetation SAR within the general area of the Project and to assist in scoping/focussing efforts for the field surveys. Dillon completed a review of the following sources and data lists prior to completing the field surveys:

- A custom Atlantic Canada Conservation Data Centre (AC CDC) report (AC CDC 2022);
- New Brunswick Department of Natural Resources and Energy Development (NBDNRED) and NBDELG publications;
    - The federal species at risk (SAR) registry;
    - The provincial species at risk registry;
    - Publicly-available Geographic Information Systems (GIS) map layers and databases;
    - High resolution aerial photography;
    - GeoNB wetland and watercourse mapping; and,
- Petitcodiac Watershed Alliance website/publications.

A custom AC CDC report was obtained for a 5 km radius around the PDA. The report lists historical observations of species of flora and fauna, including rare species, SOCC (S1, S2, and S3) and SAR within a 5 km radius from the Project site (refer to **Appendix A**). Based on the review of the AC CDC report (AC CDC 2022), there were 31 records of 23 vascular or non-vascular SOCC and no SAR historically observed within a 5 km radius of the PDA (**Table 5.5.1; Figure 5.5.2A**), though they were not located within the PDA (**Figure 5.5.2B**).

Table 5.5.1: Historical Observations of Species of Conservation Concern Located within 5 km of the PDA (AC DCC 2022)

Species	Conservation Rank	Species	Conservation Rank
Downy Rattlesnake-Plantain *Goodyera pubescens*	S1	**Maple-leaved Goosefoot** *Chenopodiastrum simplex*	S1
Hair-pointed Moss *Cirriphyllum piliferum*	S2	**Calypso** *Calypso bulbosa var. americana*	S2
Wild Leek *Allium tricoccum*	S2S3	**Canada Ricegrass** *Piptatheropsis canadensis*	S2S3
Macoun's Cudweed *Pseudognaphalium macounii*	S3	**Shining Ladies'-Tresses** *Spiranthes lucida*	S3
Bicknell's Crane's-bill *Geranium bicknellii*	S3	**Broad-Glumed Brome** Bromus latiglumis	S3
Northern Clustered Sedge *Carex arcta*	S3	**Sparse-Flowered Sedge** *Carex tenuiflora*	S3
Pubescent Sedge *Carex hirtifolia*	S3	**Hooker's Orchid** *Platanthera hookeri*	S3?
Bog Willow *Salix pedicellaris*	S3S4	**Black Ash** *Fraxinus nigra*	**COSEWIC:** Threatened S3S4
Wiegand's Sedge *Carex wiegandii*	S3S4	**White Elm** *Ulmus americana*	S3S4
Tender Sedge *Carex tenera*	S3S4	**Climbing False Buckwheat** *Fallopia scandens*	S3S4
Canada Lily *Lilium canadense*	S3S4	**Ditch Stonecrop** *Penthorum sedoides*	S3S4
Hop Sedge *Carex lupulina*	S3S4		

Notes:

S1 – Critically imperiled in the province
S2 – Imperiled in the province
S3 – Vulnerable in the province
S4 – Apparently secure
? – Inexact or uncertain
Highlighted cells indicate a non-vascular species.

According to the New Brunswick Forest inventory (i.e., publicly available GeoNB GIS database) the forest types within the LAA and PDA consist of typical forest types including softwood forests consisting of primarily white spruce and balsam fir, with stands of poplars, as well as tolerant and intolerant mixed-woods. A significant portion of the PDA contains non forested land, specifically agricultural fields.

5.5.2.3 Wetland Determination, Delineation, and Functional Assessment

Vegetation and wetlands in the PDA were surveyed and assessed by Dillon biologists certified in wetland delineation and functional assessments in New Brunswick from July 18 to 21, 2022. A follow-up wetland survey was completed on September 15, 2022. Following a desktop analysis for the PDA and LAA, vegetation (including both wetland and upland vegetation communities, with a primary focus on vegetation SOCC and SAR) and wetlands were assessed within the PDA by the implementation of the field methodologies described below.

Field Wetland Determination and Delineation

The field wetland determination and delineation methods described herein are based upon established protocols for wetland delineation, as outlined by the US Army Corps of Engineers *Wetland Delineation Manual* (Environmental Laboratory 1987). Wetland determination and delineation is focused on establishing the wetland-upland edge, and is based upon the presence of positive indicators for three parameters:

- hydric soils;
- hydrophytic vegetation; and,
- wetland hydrology.

A positive indicator must typically be present for the three parameters in order to definitively identify the boundary (edge) of a wetland. Sample points for these three parameters were established at representative locations within the wetlands.

Upon positive wetland determination (i.e., positive indicators identified for soils, hydrology and vegetation), a wetland edge condition was established based on the indicators identified at the three-parameter sample points. This edge condition was used to navigate around the perimeter of the wetland, which was in turn georeferenced with a Garmin Map64S handheld Geographical Positioning System (GPS) unit (3 to 5 m accuracy).

In order to confirm the accuracy of the boundary being delineated, additional soil samples were made using a soil auger at regular intervals during the delineation. In so doing, the presence of hydrology and soil indicators were able to be confirmed, and corroborated with the observation of wetland vegetation and topographic relief, all of which assist in the definition of the wetland edge condition.

<u>Hydric Soils</u>

Hydric soil conditions are formed when an area is exposed to flooding or saturation for a sufficient length of time during the growing season such that an anaerobic (oxygen free) environment is formed in the soil. These anaerobic conditions may manifest themselves in a variety of ways, such as through the formation of redox features (reduction-oxidation), organic soils (i.e., peat), or formation of hydrogen sulphide (i.e., rotten egg odour), among many other indicators. Interpretation of soil profiles, their associated colour, texture and presence/absence of hydric soil indicators provides the basis for judgement of whether or not any given soil is a hydric soil (USDA 2010).

Soil sampling was performed to a depth of approximately 50 cm (or to point of refusal) to identify conditions in both wetland and upland soils. Soil horizons were documented in terms of their texture, thickness, color (Munsell value/chroma/hue) and presence of hydric soil indicators (where applicable). Hydric soil indicators were determined as per the document titled *Field Indicators of Hydric Soils in the United States* (USDA 2010). Wetland Delineation Data Sheets were used to record data collected in the field. The data sheets provide the detailed soil information for each sample point, as well as list the various possible hydric soil indicators.

Hydrophytic Vegetation

Hydrophytic vegetation arises in areas where saturation or inundation by water is of duration sufficient to exert a controlling influence on the plant community assemblage. In such areas, plant species which are adapted to high-moisture environments tend to dominate. In order for a given area to classify as a wetland, hydrophytic vegetation should account for the majority (>50%) of the sample sites' total vegetation (USACE 1987).

For each plant species, there is a wetland indicator status, which may be interpreted as that species' estimated probability of occurring within a wetland (USACE 1987). If the majority of plant cover in the sample area is comprised of species with facultative (FAC), facultative wetland (FACW), or obligate (OBL) statuses, then the positive indicator for hydrophytic vegetation is met. Wetland indicator statuses for plant species were determined as per USDA Region 1 (Nova Scotia and New Brunswick) listings for interpreting USDA Wetland Indicator Statuses).

Species encountered at each of the sample locations were analysed at three strata (tree, shrub, and herbaceous) and were documented in terms of their percent (%) cover within a given plot size (i.e., 10 m, 5 m, and 2 m radius, respectively) and their wetland indicator status (i.e., FAC, FACW, and OBL).

Wetland Hydrology

Both in the soil pits prepared and over the greater area of the wetland, observations were made concerning the presence of a hydrological regime, which would sustain wetland processes. Taken into consideration were: the site context, site location, and the microtopography of the wetland area.

Primary hydrology indicators (of which at least one must be present) include surface water, high water table, saturation, sediment deposits, among many other others (USACE 1987). Secondary indicators (of which two are required, in the absence of a primary indicator) include surface soil cracks, drainage patterns and moss trim lines among others.

Functional Assessment: Wetland Ecosystem Services Protocol-Atlantic Canada (WESP-AC)

WESP-AC represents a standardized approach to the way data is collected and interpreted to indirectly yield relative estimates of a wide variety of important wetland functions and their associated benefits.

WESP-AC generates scores (0 to 10 scale) and ratings ("Lower", "Moderate", or "Higher") for a variety of wetland functions using visual assessments of weighted ecological indicators. The number of indicators that is applied to estimate a particular wetland function depends on which function is being assessed. The indicators are then combined in a spreadsheet using logic-based, mathematical models to generate the score and rating for each wetland function and benefit (NBDELG 2018b). Together they provide a profile of "what a wetland does."

For each function, the scores and ratings represent a particular wetland's standing relative to those in a statistical sample of non-tidal wetlands previously assessed in the province (98 for New Brunswick) (NBDELG 2018b). **Table 5.5.2** provides a list of various functions, their definitions, and potential benefits.

Table 5.5.2: Benefits of Wetland Functions Scored by WESP-AC

Function	Definition	Potential Benefits
Hydrologic Functions:		
Water Storage and Delay	The effectiveness for storing runoff or delaying the downslope movement of surface water for long or short periods.	Flood control, maintain ecological systems.
Stream Flow Support	The effectiveness for contributing water to streams especially during the driest part of a growing season.	Support fish and other aquatic life.
Water Quality Maintenance Functions:		
Water Cooling	The effectiveness for maintaining or reducing temperature of downslope waters.	Support cold water fish and other aquatic life.
Sediment and Retention Stabilization	The effectiveness for intercepting and filtering suspended inorganic sediments thus allowing their deposition, as well as reducing energy of waves and currents, resisting excessive erosion, and stabilizing underlying sediments or soil.	Maintain quality of receiving waters. Protect shoreline structures from erosion.
Phosphorous Retention	The effectiveness for retaining phosphorus for long periods (>1 growing season).	Maintain quality of receiving waters.
Nitrate Removal and Retention	The effectiveness for retaining particulate nitrate and converting soluble nitrate and ammonium to nitrogen gas while generating little or no nitrous oxide (a potent greenhouse gas).	Maintain quality of receiving waters.
Organic Nutrient Transport	The effectiveness for producing and subsequently exporting organic nutrients (mainly carbon), either particulate or dissolved.	Support food chains in receiving waters.
Ecological (Habitat) Functions:		
Fish Habitat	The capacity to support an abundance and diversity of native fish (both anadromous and resident species).	Support recreational and ecological values.
Aquatic Invertebrate Habitat	The capacity to support or contribute to an abundance or diversity of invertebrate animals which spend all or part of their life cycle underwater or in moist soil. Includes dragonflies, midges, clams, snails, water beetles, shrimp, aquatic worms, and others.	Support salmon and other aquatic life. Maintain regional biodiversity.

Function	Definition	Potential Benefits
Amphibian and Reptile Habitat	The capacity to support or contribute to an abundance or diversity of native frogs, toads, salamanders, and turtles.	Maintain regional biodiversity.
Waterbird Feeding Habitat	The capacity to support or contribute to an abundance or diversity of waterbirds that migrate or winter but do not breed in the region.	Support hunting and ecological values. Maintain regional biodiversity.
Waterbird Nesting Habitat	The capacity to support or contribute to an abundance or diversity of waterbirds that nest in the region.	Maintain regional biodiversity.
Songbird, Raptor, and Mammal Habitat	The capacity to support or contribute to an abundance or diversity of native songbird, raptor, and mammal species and functional groups, especially those that are most dependent on wetlands or water.	Maintain regional biodiversity.
Native Plant Habitat and Pollinator Habitat	The capacity to support or contribute to a diversity of native, hydrophytic, vascular plant species, communities, and/or functional groups, as well as the pollinating insects linked to them.	Maintain regional biodiversity and food chains.
Public Use and Recognition*	Prior designation of the wetland, by a natural resource or environmental agency, as some type of special protected area. Also, the potential and actual use of a wetland for low-intensity outdoor recreation, education, or research.	Commercial and social benefits of recreation. Protection of public investments.

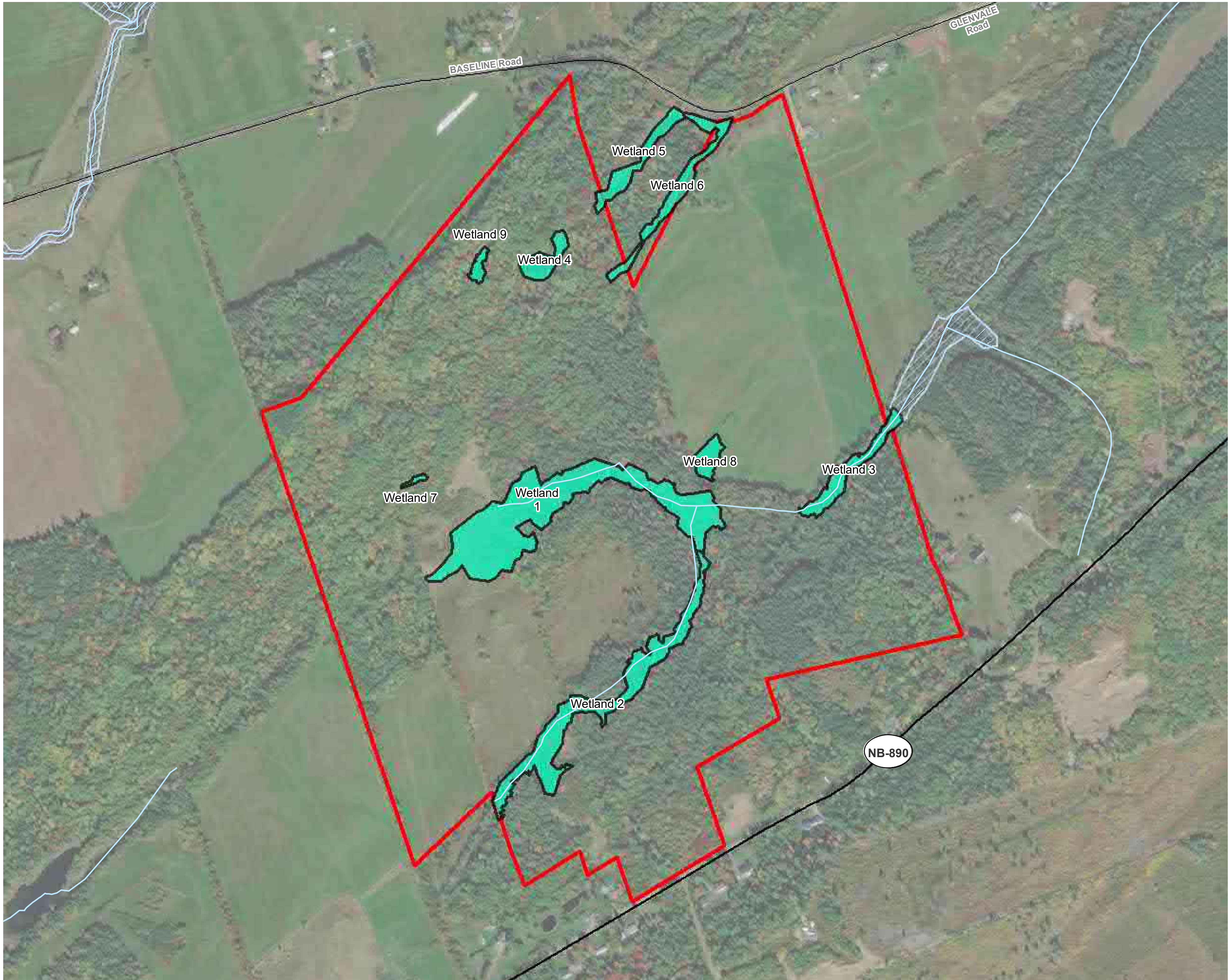
**Considered a benefit rather than a function of wetlands*

Source: NBDELG (2018b)

During the field analysis conducted between July 19- 22, 2022, nine unmapped wetlands were identified, delineated, and functionally assessed within the PDA (refer to **Figure 5.5.1**). The delineated wetlands are summarized in **Table 5.5.3**, below.

Table 5.5.3: Summary of Wetland Findings

Wetland Identifier	Wetland Type	Delineated Area (ha)	Area (ha) of Wetland to be Potentially Affected by the Project activities
Wetland 1 (WL1)	1A: Disturbed field wetland 1B: Willow swale wetland 1C: Mixed-wood riparian wetland	2.93	1.95
Wetland 2 (WL2)	Mixed-wood riparian wetland	1.49	0.00
Wetland 3 (WL3)	Mixed-wood riparian wetland	0.44	0.00
Wetland 4 (WL4)	Formed in a depression due to karst topography	0.28	0.28
Wetland 5 (WL5)	Formed in a depression due to karst topography	0.39	0.03
Wetland 6 (WL6)	Formed in a depression due to karst topography	0.52	0.04
Wetland 7 (WL7)	Formed in a depression due to karst topography	0.03	0.03
Wetland 8 (WL8)	Disturbed alder swamp	0.2	0.00
Wetland 9 (WL9)	Formed in a depression due to karst topography	0.09	0.09
	Total Wetland Area	**6.36**	**2.43**



HAMMOND RIVER HOLDINGS LIMITED
PROPOSED GLENVALE GYPSUM QUARRY

WETLANDS
FIGURE 5.5.1

- Highway
- Road
- Watercourses
- FieldDelineatedWetlands
- Project Development Area
- Wetland (NBDELG 2021)

0 37.5 75 150 Meters
SCALE 1:6,000

N W E S

MAP DRAWING INFORMATION:
DATA PROVIDED BY DILLON CONSULTING LIMITED, CANVEC
SERVICE LAYER CREDITS: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), SWISS TOPO, OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

MAP CREATED BY: RP
MAP CHECKED BY: JO
MAP PROJECTION: NAD_1983_CSRS_NEW_BRUNSWICK_STEREOGRAPHIC

DILLON CONSULTING

PROJECT: 22-4280
STATUS: FINAL
DATE: 2022-09-22

The following sections provide a summary of the wetland delineation results for the wetlands located within the PDA. There were no GeoNB mapped wetlands located within the PDA; the nearest mapped wetland is located on the adjacent property to the northeast of the site, along the same unnamed stream that traverses the PDA (converges into North River just northeast of the PDA; **Figure 5.5.1**). Further details of the wetland's primary and secondary indicators and attributes as well as WESP-AC functional assessment results is provided in **Appendix B**. Refer to **Figure 5.5.1** for approximate wetland field delineations. It is important to note that the field assessment was completed for only that wetlands that are present entirely within the PDA and for the portion of wetlands that are present on the PDA for wetlands that extend to other neighbouring properties, to avoid trespassing on privately-owned property.

Wetland 1 (WL1) – 2.93 ha Disturbed Field/Willow Swale/Forested Riparian Wetland Complex

Based on the results of the field assessment, WL1 is characterized as a disturbed field wetland (*Salix*, *Scirpus*, and *Calamagrostis* dominated) and a willow swale, which form the water source for the unnamed stream that runs through the forested riparian characterization of the wetland complex. WL1 is 2.93 ha, which consists of approximately 0.64 ha of disturbed field condition, 0.3 ha of willow swale condition, and 1.99 ha of forested riparian wetland condition. The wetland is an outflow wetland, draining easterly (**Figure 5.5.1**).

Wetland 1A – Disturbed Field Condition

Due to the disturbed nature of the field condition (farming), there are no overstory (trees) within this section of the wetland. The shrub layer had sporadic willows (*Salix* spp.) growing throughout. The herbaceous layer was dominated by bluejoint reed grass (*Calamagrostis canadensis*), mosquito bulrush (*Scirpus hattorianus*), and sensitive fern (*Onoclea sensibilis*).

Wetland 1B – Willow Swale Condition

There is no overstory in this condition of the wetland. The shrub layer is dominated by willows and red osier dogwood (*Cornus sericea*). The herbaceous layer was dominated by bluejoint reed grass, slender manna grass (*Glyceria melicaria*), dwarf red raspberry (*Rubus pubescens*), horsetails (*Equisetum* spp.), and large-leaved avens (*Geum macrophyllum*).

Wetland 1C – Forested Riparian Swamp Condition

The overstory of the forested condition of the wetland is dominated by Eastern white cedar (*Thuja occidentalis*). The sporadic shrub layer contained mostly beaked hazelnut (*Corylus cornuta*) and trembling aspen (*Populus tremuloides*) saplings. The herbaceous layer was dominated by sensitive fern, bluejoint reed grass, creeping buttercup (*Ranunculus repens*), and small enchanter's nightshade (*Circaea alpina*).

The vegetation community identified at WL1 is comprised of greater than 50% wet-adapted vegetation species based on their indicator status (i.e., obligate, facultative wet, facultative, facultative upland,

upland; USACE 1987); therefore, this wetland is considered to have a "hydrophytic" or wet adapted vegetation community. There were no flora SAR or SOCC observed during desktop or field delineations of this wetland. The wetland also had wet soil indicators in the form of a thick organic layer at the surface that is slower to decompose due to wet conditions, and iron concentrations in the soil, indicating that the water table regularly moves into the soil. The origin of the wetland is unknown.

Wetland 2 (WL2) – 1.49 ha Riparian Mixed-wood Swamp

Based on the results of the field assessment, WL2 is characterized as a 1.49 ha riparian mixed-wood swamp, located along the unnamed WC2 that runs through the PDA. The wetland drains easterly, out of the PDA, and eventually into the North River (**Figure 5.5.1**). The treed over-story is dominated by black cherry. The shrub layer is dominated by black cherry (*Prunus serotina*) and speckled alder (*Alnus incana*). The understory herbaceous layer is dominated by sensitive fern. The vegetation community identified at WL2 is comprised of greater than 50% wet adapted vegetation species based on their indicator status (i.e., obligate, facultative wet, facultative, facultative upland, upland; USACE 1987); therefore, this wetland is considered to have a "hydrophytic" or wet adapted vegetation community. There were no flora SAR or SOCC observed during desktop or field delineations of this wetland. The wetland also had wet soil indicators in the form of a layer of black muck and organics over a layer containing leached inclusions. Hydrology indicators include saturation, drainage patterns, drift deposits, water-stained leaves, and a high-water table.

Wetland 3 (WL3) – 0.44 ha Riparian Mixed-wood Swamp

Based on the results of the field assessment, WL3 is characterized as a 0.44 ha riparian mixed-wood swamp, located along WC1 that runs through the PDA. The wetland drains easterly, out of the PDA, and eventually into the North River (**Figure 5.5.1**). The treed over-story is dominated by balsam fir (*Abies balsamea*) and red spruce (*Picea rubens*). The shrub layer is dominated by black cherry (*Prunus serotina*). The understory herbaceous layer is dominated by ostrich fern (*Matteuccia struthopteris*). The vegetation community identified at WL3 is comprised of greater than 50% wet adapted vegetation species based on their indicator status (i.e., obligate, facultative wet, facultative, facultative upland, upland; USACE 1987); therefore, this wetland is considered to have a "hydrophytic" or wet adapted vegetation community. There were no flora SAR or SOCC observed during desktop or field delineations of this wetland. The wetland also had wet soil indicators in the form of a layer of soil in which the processes of reduction or translocation have removed iron creating soil with low chroma and high value (depleted matrix). The origin of the wetland is topography/the stream.

Wetland 4 – 0.28 ha Karst Topography Depression Wetland

Based on the results of the field assessment, WL4 is a 0.28 ha wetland formed in a depression as a result of the karst topography in the area, located toward the north of the PDA (**Figure 5.5.1**). The treed over-story is dominated by red maple. The shrub layer is dominated by Eastern white cedar saplings, willow, and beaked hazelnut (*Corylus cornuta*). The understory herbaceous layer is dominated by bittersweet nightshade (*Solanum dulcamara*), sensitive fern, spotted water-hemlock (*Cicuta maculata*), and false waterpepper (*Persicaria hydropiperoides*). The vegetation community identified at WL4 is comprised of greater than 50% wet adapted vegetation species based on their indicator status (i.e., obligate, facultative wet, facultative, facultative upland, upland; USACE 1987); therefore, this wetland is considered to have a "hydrophytic" or wet adapted vegetation community. There were no flora SAR or SOCC observed during desktop or field delineations of this wetland. The wetland also had wet soil indicators in the form of sandy redox. Hydrology indicators include surface water, high water table, saturation, water-stained leaves, aquatic fauna, and hydrogen sulphide odour. The origin of the wetland is a depression in the karst topography.

Wetland 5 (WL5) – 0.39 ha Karst Topography Depression Wetland

Based on the results of the field assessment, WL5 is 0.39 ha wetland created in a depression due to the karst topography in the area. The wetland is likely hydrologically connected with the ditch along Baseline Road during some of the year (**Figure 5.5.1**). The treed over-story is dominated by red maple and balsam fir. There is no shrub layer. The understory herbaceous layer is dominated by sensitive fern. The vegetation community identified at WL5 is comprised of greater than 50% wet adapted vegetation species based on their indicator status (i.e., obligate, facultative wet, facultative, facultative upland, upland; USACE 1987); therefore, this wetland is considered to have a "hydrophytic" or wet adapted vegetation community. There were no flora SAR or SOCC observed during desktop or field delineations of this wetland. The wetland also had wet soil indicators in the form of a thick layer of mucky organic matter (histosol). The origin of the wetland is likely the karst topography of the area.

Wetland 6 (WL6) – 0.52 Karst Topography Depression Wetland

Based on the results of the field assessment, WL6 is a 0.52 ha wetland formed in a depression as a result of the karst topography in the area, located along the dirt road within the PDA. The wetland likely drains easterly, into the ditch along Baseline Road (**Figure 5.5.1**). The treed over-story is dominated by red maple and Eastern white cedar. The shrub layer is dominated by red-osier dogwood (*Cornus cornuta*). The understory herbaceous layer is dominated by duckweed (*Lemna* spp.). The vegetation community identified at WL6 is comprised of greater than 50% wet adapted vegetation species based on their indicator status (i.e., obligate, facultative wet, facultative, facultative upland, upland; USACE 1987); therefore, this wetland is considered to have a "hydrophytic" or wet adapted vegetation community. There were no flora SAR or SOCC observed during desktop or field delineations of this wetland. The wetland also had wet soil indicators in the form of a thick layer of mucky organic matter (histosol) and a strong hydrogen sulphide smell. Hydrology indicators include surface water, high water table, saturation, and hydrogen sulphide odour. The origin of the wetland is likely the karst topography of the area.

Wetland 7 (WL7) – 0.03 ha Karst Topography Depression Wetland

Based on the results of the field assessment, WL7 is characterized as a 0.03 ha wetland formed in a depression as a result of the karst topography in the area. The wetland is located centrally in the PDA (**Figure 5.5.1**) and may be hydrologically connected to other karst depressions via drainages at certain times of the year. The wetland itself is not conducive to growing vegetation as it is entirely covered with surface water, and does not contain aquatic vegetation, such as duckweed, that other similar wetlands within the PDA contain. The banks of the wetland are steep; thus, the wetland does not have a fringe area where wet plants can grow. It transitions almost immediately from surface water to upland habitat. It was also difficult to characterize the soil within the wetland as it was entirely covered in surface water, but it is likely to be high in organic material. Hydrological indicators include surface water, saturation, and a high-water table.

Wetland 8 (WL8) – 0.2 ha Disturbed Alder Swamp in Fallow Field

Based on the results of the field assessment, WL8 is characterized as a 0.2 ha disturbed alder swamp, located in a fallow farm field. The wetland has inputs, draining into it from the east, which are man-made drainages through the field (**Figure 5.5.1**). There is no treed over-story in this wetland. The shrub layer is dominated by speckled alder. The understory herbaceous layer is dominated by bristly dewberry (*Rubus hispidus*), bluejoint reed grass, and slender manna grass (*Glyceria melicaria*). The vegetation community identified at WL8 is comprised of greater than 50% wet adapted vegetation species based on their indicator status (i.e., obligate, facultative wet, facultative, facultative upland, upland; USACE 1987); therefore, this wetland is considered to have a "hydrophytic" or wet adapted vegetation community. There were no flora SAR or SOCC observed during desktop or field delineations of this wetland. The wetland also had wet soil indicators in the form of redox features and leaching, though it was difficult to classify due to anthropogenic influences. Hydrology indicators include drainage patterns and drift deposits.

Wetland 9 (WL9) – 0.09 ha Karst Topography Depression Wetland

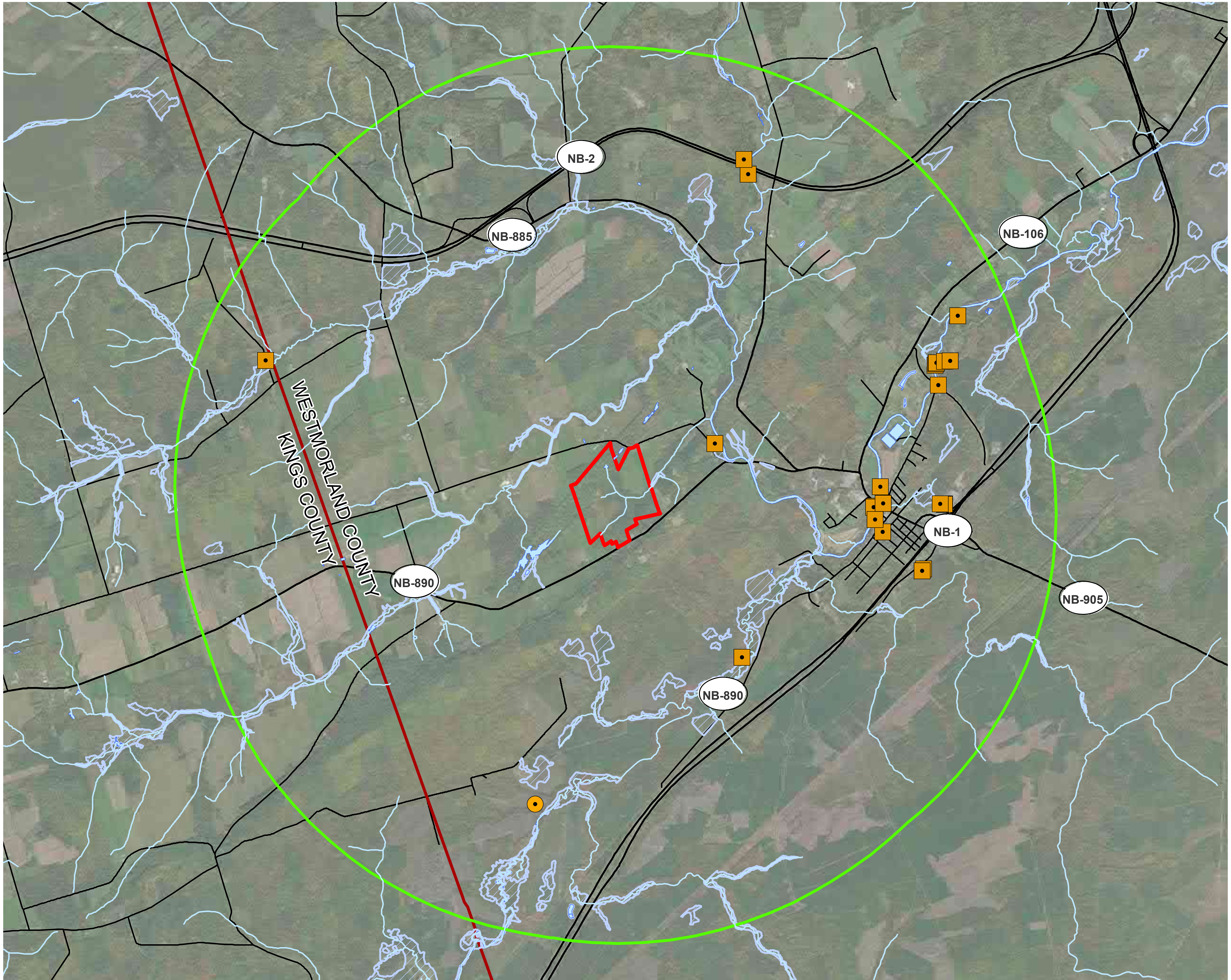
Based on the results of the field assessment, WL9 is a 0.09 ha wetland formed in a depression as a result of the karst topography in the area, located at the north of the PDA (**Figure 5.5.1**). The wetland lacks a treed over-story and shrub layer. The understory herbaceous layer is dominated by sensitive fern and ostrich fern (*Matteucia struthiopteris*). The vegetation community identified at WL9 is comprised of greater than 50% wet adapted vegetation species based on their indicator status (i.e., obligate, facultative wet, facultative, facultative upland, upland; USACE 1987); therefore, this wetland is considered to have a "hydrophytic" or wet adapted vegetation community. There were no flora SAR or SOCC observed during desktop or field delineations of this wetland. The wetland also had wet soil indicators in the form of a gleyed matrix. Hydrology indicators include a high-water table (soil pit filled quickly to 15 cm below the surface) and drift deposits.

Wetland and Upland Vegetation Communities

In addition to the characterization of wetland vegetation communities during wetland delineations, upland vascular vegetation communities were inventoried by a Dillon biologist skilled in the identification of common and rare plant species in New Brunswick. The vascular plant inventory for the PDA was completed during site visits between July 19 and 22, 2022 (**Figure 5.5.2A** and **Figure 5.5.2B**). Additionally, a characterization of land cover was derived from the field inventories and then further refined during the compilation of plant species lists. Refer to the master plant species lists for the site provided in **Appendix C**.

Roughly 15 ha (18%) of the PDA was cut over for logging purposes beginning in Fall 2021. Approximately 26.5 ha (31%) of the PDA is former farmed fields. The remaining forest cover is mostly associated with wetland areas and stream buffers to the southern portions of the PDA, as well as some limited tree "islands" in the centre of the PDA that are associated with sinkholes. Due to the nature and land use of the area, much of the land surrounding the PDA is residential or agricultural in nature.

Although there were no historical observations of SAR or SOCC identified within the PDA during the AC CDC records review, 25 specimens of black ash (*Fraxinus nigra*) were encountered in the field along WC1, with a diameter at breast height (DBH) ranging between 5 and 30 cm. There was a stand of 20 specimens, along with other sporadic individuals. Black ash is listed as Threatened under COSEWIC, and is under consideration for addition to Schedule 1 of SARA. They are ranked as Vulnerable to Apparently Secure (S3S4) by the AC CDC. During the field visit, multiple specimens of white elm (*Ulmus americana*) were also recorded along WC1. White elm is ranked as vulnerable to apparently secure under the AC CDC (AC CDC 2022).



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PROPOSED GLENVALE GYPSUM QUARRY

HISTORICAL RECORDS OF VEGETATION SAR SOCC AND BIOLOGICALLY SIGNIFICANT SITES WITHIN 5 KM OF THE PDA
FIGURE 5.5.2A

- Species of Conservation Concern, Nonvascular Plant
- Species of Conservation Concern,Vascular Plant
- Highway
- Road
- Watercourse
- Project Development Area
- Search Radius 5km
- Waterbodies
- Wetland (NBDELG 2021)

0 250 500 1,000 Meters
SCALE 1:47,235
N W E S

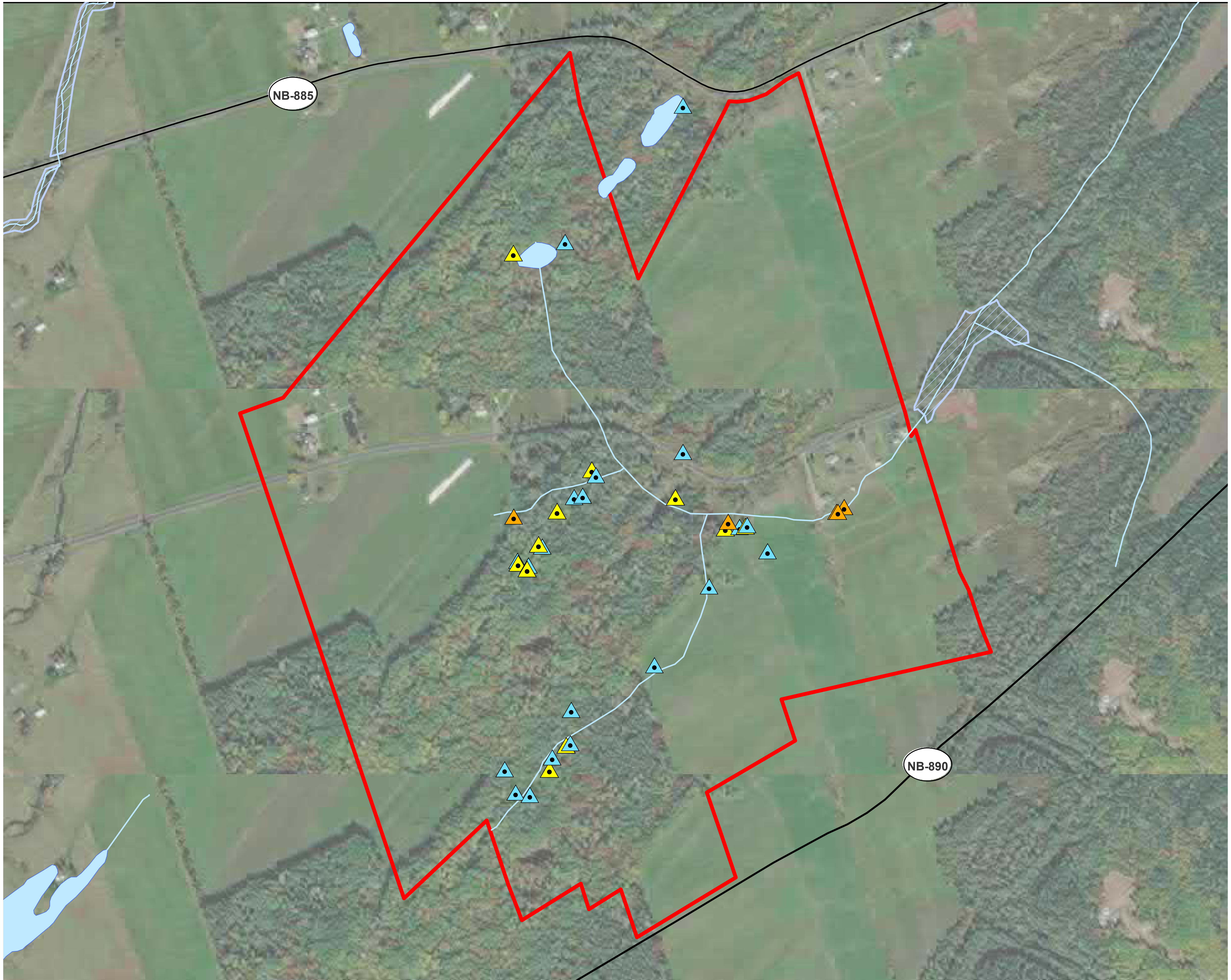
MAP DRAWING INFORMATION:
DATA PROVIDED BY DILLON CONSULTING LIMITED, CANVEC
SERVICE LAYER CREDITS: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), SWISS TOPO, OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

MAP CREATED BY: RP
MAP CHECKED BY: JO
MAP PROJECTION: NAD_1983_CSRS_NEW_BRUNSWICK_STEREOGRAPHIC

DILLON CONSULTING

PROJECT: 22-4280
STATUS: FINAL
DATE: 2022-09-21

FILE LOCATION: K:\2022\224280\Product\Client\Glenvale\Figure 5.5.2 Historical Records of Vegetation SAR SOCC within 5 km of the PDAV2.mxd



HAMMOND RIVER HOLDINGS LIMITED
PROPOSED GLENVALE GYPSUM QUARRY

FIELD IDENTIFIED VEGETATION SAR SOCC AND BIOLOGICALLY SIGNIFICANT SITES WITHIN THE PDA
FIGURE 5.5.2B

- Exotic/Invasive,Vascular Plant
- Exotic,Vascular Plant
- Species of Conservation Concern,Vascular Plant, Feild Identified
- Highway
- Road
- Watercourse
- Project Development
- Search Radius 5km
- Waterbodies
- Wetland (NBDELG 2021)

0 25 50 100 Meters

SCALE 1:5,600

N W E S

MAP DRAWING INFORMATION:
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MAP CREATED BY: RP
MAP CHECKED BY: JO
MAP PROJECTION: NAD_1983_CSRS_NEW_BRUNSWICK_STEREOGRAPHIC

PROJECT: 22-4280
STATUS: FINAL
DATE: 2022-09-21

FILE LOCATION: K:\2022\224280\Product\Client\Glenvale\Figure 5.5.2B Field Identified Vegetation SAR SOCC within 5 km of the PDAV2.mxd

5.5.3 Environmental Effects Assessment

The potential environmental effects of the Project on vegetation and wetlands are assessed in this section.

5.5.3.1 Potential Effects

The Project is expected to interact with vegetation and wetlands throughout each phase (i.e., construction, operation, and reclamation and closure). The primary possible effects to wetlands include direct loss of wetland area or function for those wetlands within the PDA that will be subject to Project activities such as site clearing, grubbing, and construction of infrastructure, access roads, and blasting/extraction of gypsum. In addition, indirect loss of wetland area or function of regulated wetlands may occur on other wetlands located outside the PDA but within the LAA (e.g., wetlands on adjacent properties to the Project site) through changes in surface hydrology within the PDA as a result of the development of the Project site and the presence of the open pit. The primary possible effects to vegetation include the direct loss of vegetation communities through clearing and grubbing. More specifically, the Project may interact with vegetation and wetlands in the following ways:

- The construction and operation phases of the Project will result in the direct loss of approximately 2.43 ha of field-delineated wetlands within the PDA;
- The construction and operation phases of the Project may result in the indirect loss of wetland area or function associated with wetlands on neighbouring properties to the PDA, specifically those wetlands located downstream from the wetlands and streams in the PDA (to the east of the PDA).
- Construction activities (e.g., road and infrastructure development) that may occur within 30 m of wetlands have the potential to alter natural drainage patterns and increase erosion rates.
- A spill or fire could occur as an accident or unplanned event (refer to **Section 7.0**) which could affect wetlands and vegetation within the PDA and LAA.
- Wetlands and vegetation may interact with the Project during reclamation and closure through re-establishment of vegetation communities and wetland areas (potential for incorporation of wetlands restoration within the PDA).

5.5.3.2 Mitigation

Mitigation is identified for each interaction or effect in relation to vegetation and wetlands in an attempt to prevent the interaction from occurring, if possible, or to reduce the severity, magnitude, geographic extent, frequency, or duration of the interaction. Best management practices (based on industry guidelines and regulatory guidance documents) have been identified as appropriate mitigative strategies. In addition, several acts, codes, regulations, and guidelines may require appropriate actions to be conducted as mitigative measures prior to or during the interaction. The following mitigation will be implemented as part of the Project:

- The area to be disturbed by the Project will be minimized to the extent possible (i.e., limited to the area which is required to accomplish the Project objectives);
- Surface water drainage will be designed to minimize changes in hydrological regimes within the LAA;
- Perimeter drainage ditches will be installed in low-lying areas around the PDA to assist in the management of surface water on-site;
- Efforts will be made to maintain as much mature vegetation along the edges of the site;
- A watercourse and wetland alteration (WAWA) permit will be obtained by NBDELG prior to work within 30 metres of a watercourse or wetland within the PDA;
- A Wetland Compensation Plan will be developed outlining compensation measures due to lost wetland area and function, subject to approval by NBDELG;
- Construction and operation activities will comply with all conditions of the WAWA permit;
- Proper erosion and sediment control (ESC) measures (i.e., check dams, silt fences, etc.) will be installed where appropriate and will be checked regularly and prior to and after storm events to confirm they are continuing to operate properly to minimize potential effects to adjacent wetlands and watercourses;
- All construction equipment will be properly cleaned prior to mobilizing to and from site (known invasive species on site) to avoid potential introduction and spread of invasive species;
- A Water Management Plan will be implemented that incorporates measures aimed at retaining site water in a pit sump and settling pond to allow for settling of suspended sediments prior to release to the environment; and,
- An Emergency Response Plan (ERP) will be developed for accidental spills, emergencies, incidents or storm events, and will be detailed in the Environmental Protection Plan (EPP), and the contractor will be required to provide spill response training to construction personnel.

5.5.3.3 Characterization of Residual Effects

The Project will result in the direct loss of 2.43 ha of wetland within the PDA, to allow for the construction of the quarry, stockpiles, settling pond, and other related surface activities. This is an unavoidable loss to accomplish the Project, which will occur during construction and persist through the life of the Project. There are no provincially significant wetlands (PSWs) in the PDA which will be impacted. The Project has been developed to minimize the area of disturbance of the PDA to that which is required to meet the Project objectives, maintaining treed buffers around watercourses and wetlands to the extent possible, to minimize the net loss of wetland function.

During operation, it is anticipated that additional indirect loss of, or alterations to, wetlands and wetland functions located in the PDA and on neighbouring properties to the Project site may occur from localized changes in surface water hydrology arising from the reshaping of the Project site and the storage of runoff in the pit sump and settling pond. Although not specifically located in the PDA, there is a provincially-mapped riparian wetland located downstream of the PDA, which is contiguous to watercourses WC1 and WC2 and wetlands WL1 and WL2. This wetland will likely experience indirect effects as a result of water management in the PDA. This indirect loss cannot be characterized at this early stage and ongoing follow-up and monitoring (with adaptive management as necessary) will be conducted to monitor potential changes that may occur to this downstream wetland and to plan response actions. Wetlands that are located on adjacent properties (especially downstream, i.e., easterly) may experience indirect net loss of wetland function due to potential localized changes in surface water hydrology due to the presence of the Project and will be monitored through the life of the Project and retroactively subjected to a WAWA permit and associated compensation, as an adaptive management measure, if necessary.

Without mitigation, construction activities and some operation activities could result in direct net loss of functions to existing and nearby wetlands. The implementation of the practice “avoid”, “minimize”, and/or “compensate” will be considered for potential impacts to the wetlands within the PDA and LAA. Applicable authorization (i.e., WWA permit and associated compensation) will be secured with NBDELG prior to undertaking construction activities within 30 m that could affect wetlands, will reduce the potential net loss of wetland function. Follow-up monitoring of potential indirect effects on wetlands located on adjacent properties will be conducted, and if indirect effects are identified during this monitoring, the implementation of adaptive management measures would be initiated to minimize such loss, with appropriate WAWA permitting and compensation for retroactive net loss of wetland function if required.

The direct/indirect net loss of wetland function in wetlands that are deemed by NBDELG to result in a “net loss of wetland function” under the New Brunswick Wetlands Conservation Policy (NBDNRE-NBDELG 2002) requires wetland compensation for loss of wetland function at a 2:1 ratio.

Though much of the site has already been cleared for logging purposes, the Project will result in the loss of immature vegetation within the PDA so that the Project facilities can be developed. There are known occurrences of SOCC on-site: black ash and white elm, located along WC1. These black ash and white elm specimens are likely to be disturbed by the stockpile areas, as the Project is currently designed. As black ash and white elm are not SAR, there is no provincial or federal legislation protecting these species. However, the Hammond River Holdings will offer Indigenous communities to harvest these trees for their own purposes if so desired.

For construction equipment mobilizing to the site and working within 30 m of a wetland, contractors will be required to properly clean equipment prior to mobilizing to the site so as to avoid the transfer of invasive species to the area. Equipment will also be cleaned prior to leaving site to avoid spreading the known invasive species on site (i.e., glossy buckthorn, purple loosestrife) from spreading to other areas of the province.

5.5.4 Summary

Based on the above, with planned mitigation, authorization (with compensation), and environmental protection measures, the residual environmental effects on the Project on vegetation and wetlands during each phase of the Project are rated as not significant, with a moderate level of confidence. The implementation of water management features, water quality monitoring, groundwater level monitoring, wetland function monitoring, and other follow-up and monitoring measures to be implemented to monitor changes to wetland function arising from the Project, with adaptive management measures implemented as necessary to address those changes, will improve the confidence of this prediction.

5.6 Wildlife and Wildlife Habitat

The potential environmental effects of the Project on wildlife and wildlife habitat are assessed in this section.

5.6.1 Scope of VC

Wildlife and wildlife habitat includes wildlife (fauna) and the habitats that support wildlife species. This VC is focused on birds, mammals, invertebrates, and herptiles within terrestrial components of their lifecycle, as well as the habitats that support them. Wildlife and wildlife habitat is selected as a VC because of potential interactions between wildlife, its habitat, and proposed Project activities. Species of conservation interest (i.e., species at risk [SAR] and species of conservation concern [SOCC]) as identified by provincial and federal regulatory agencies, are of particular focus in this assessment because they are often susceptible to changes in the environment and are therefore useful indicators of ecosystem health and regional biodiversity.

Both provincial and federal legislation provides protection to designated bird, mammal, herptile, and other species at risk. Most bird species, specifically, are protected under the *Migratory Birds Convention Act* (MBCA). The wildlife and wildlife habitat VC has connections to the vegetation and wetlands VC (**Section 5.5**) because of its relationship with vegetation, hydrology, landform, and soil components.

In this report, we define "species at risk" (abbreviated SAR) as those species that are listed as "Extirpated", "Endangered", "Threatened", or "Special Concern" on Schedule 1 of the federal *Species at Risk Act* (SARA) or the New Brunswick *Species at Risk Act* (NB SARA). We also define "species of conservation concern" (abbreviated SOCC) as those species that are not SAR but are listed in other parts of SARA, NB SARA, COSEWIC, or as regionally rare or endangered by the AC CDC (i.e., those species with AC CDC S-ranks of "extremely rare" [S1], "rare" [S2] or "uncommon" [S3]).

To provide information on potential occurrences of rare and endangered wildlife, and unique or sensitive wildlife habitats potentially existing within and/or near the PDA, a review of the following existing data and information sources was conducted:

- Previous background information from other similar assessments completed in the general project area;
- Listed species by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC);
- Listed species under the federal *Species at Risk Act* (SARA);
- Listed species under the New Brunswick *Species at Risk Act* (NB SARA); and,
- Ranked species by the New Brunswick Department of Natural Resources and Energy Development (NBDNRED).

As part of the desktop assessment, a site-specific AC CDC report (AC CDC 2022) was obtained for the Project area (refer to **Appendix A)**. The report provided historical observations of SAR/SOCC flora and fauna species, as well as identified environmentally sensitive or managed areas within 5 km of the Project footprint. Wildlife SOCC identified as extremely rare (S1), rare (S2) or uncommon (S3) are also identified.

Other available background information sources and mapping reviewed to identify and assess wildlife and wildlife habitat presence at the Project location included:

- Ecological Reserves in the Maritimes;
- Environmentally Sensitive Areas database;
- Atlas of Breeding Birds of the Maritime Provinces;
- Important Bird Areas of Canada;
- Federally designated Migratory Bird Sanctuaries;
- Provincially identified deer wintering areas; and,
- Identified Protected Natural Areas, and Wildlife Management Zones.

Incidental observations conducted during wetland and vegetation survey efforts were used to collect information on the presence of wildlife within the LAA, with an emphasis on SAR/SOCC.

5.6.1.1 Temporal Boundaries

The temporal boundaries for the Project include the following:

- **Construction**: extending for a period of approximately four months, anticipated to begin in the fourth quarter (Fall) of 2023 (subject to the receipt of all approvals and permits required for the Project);
- **Operation**: beginning in approximately the first quarter of 2024, and lasting for approximately 10 years or until the mineral resource has been depleted; and,

- **Reclamation and closure**: to be initiated following the completion of operations at the site, with decommissioning and reclamation of the surface facilities at the site for an anticipated duration of six months following operation.

5.6.1.2 Spatial Boundaries

The Project development area (PDA) consists of an area of approximately 85 ha (i.e., conservatively assumed to be the entirety of PIDs 00814160, 70076948, and 70654058) that includes the open pit and all related surface facilities located on the property. The PDA consists of an irregularly-shaped property, with approximate maximum dimensions of 950 m in an east-west direction, by 1,200 m in a north-south direction (refer to **Figure 1.2.1**). The PDA is the area represented by the physical Project footprint.

The local assessment area (LAA) is the maximum anticipated area within which Project-related environmental effects are expected. For wildlife and wildlife habitat, the LAA includes the PDA and areas within approximately 300 m beyond the PDA where Project-related environmental effects could be expected to occur.

5.6.1.3 Significance Threshold

A significant adverse residual environmental effect on wildlife and wildlife habitat is one where the population of a species is sufficiently affected to cause a decline in abundance and/or change in distribution, beyond which natural recruitment (reproduction and immigration from unaffected areas) would not return the population to its former level within several generations.

5.6.2 Existing Conditions

Information regarding the use of the LAA by wildlife and presence of wildlife habitat was derived from several sources including existing databases and secondary information sources, as well as bird surveys and incidental recordings of wildlife species evidence, recorded during bird, wetland, aquatic, and vegetation surveys.

5.6.2.1 Resident and Migratory Birds

The vast majority of bird species found in New Brunswick are migratory and either breed in the province during the summer months, or pass through it during the spring and fall migratory periods. Jurisdiction for many migratory birds is federal, since migratory birds cross both provincial and international boundaries. The *Migratory Birds Convention Act* (MBCA) is the federal law which protects migratory birds in both Canada and the United States. The Act prohibits killing, injuring or harassing migratory birds, their nests, or their young. Furthermore, species listed pursuant the federal *Species at Risk Act* or New Brunswick *Species at Risk Act* are afforded further protection as harm, the destruction of their nest, eggs or young is prohibited. Migratory birds that are protected under the MBCA in Canada, and that are relevant to the Project, include:

- Waterfowl (e.g., ducks and geese);

- Rails (e.g., coots, gallinules, sora, and other rails);
- Shorebirds (e.g., plovers and sandpipers); and,
- Songbirds (e.g., thrushes and warblers).

Birds not addressed under federal jurisdiction include grouse, quail, pheasants, ptarmigan, hawks, owls, eagles, falcons, cormorants, pelicans, crows, jays, and kingfishers. Most birds not included in this list are protected under provincial laws, most notably the New Brunswick *Fish and Wildlife Act*. The New Brunswick *Fish and Wildlife Act* protects all fish and wildlife species (including all vertebrate animals or birds) from angling, hunting, trapping and other forms of intentional take, except under the authority of permits or licences. The Act also prohibits the disturbance, gathering or collection of the nests or eggs of any bird species, except under the authority of a permit. Under Section 4 of the Act, some wildlife and bird species (including American Crow [*Corvus brachyrhynchos*], Double-crested Cormorant [*Phalacrocorax auritus*], and European Starling [*Sturnus vulgaris*]) may be taken if they present a risk of injury to landowners, or a risk of property damage, but this requires a separate permit.

Maritime Breeding Bird Atlas

The Maritime Breeding Bird Atlas (MBBA) database (Stewart et al. 2015) provides information on the presence of breeding bird species in counts conducted between 2006 and 2010. Within the MBBA Second Atlas, the PDA lies within Region #13: Petitcodiac, at the northeast corner of Square #20LR28 (Anagance). During the MBBA period of 2006-2010, a total of 79 species of birds were recorded within Square #20LR28. Of these species, 13 were confirmed as breeding, 19 were probable breeders, and 47 were possible breeders. There were four SAR, seven SOCC, and three exotic species detected during the most recent MBBA period in this square (refer to **Table D.1** in **Appendix D**). The species at risk included: Bald Eagle (*Haliaeetus leucocephalus*), Barn Swallow (*Hirundico rustica*), Canada Warbler (*Cardellina canadensis*), and Bobolink (*Dolichonyx oryzivorus*; Stewart et al. 2015).

NBDNRED's General Status of Wild Species (NBDNRED 2021) reports that there are 407 extant bird species known to occur in New Brunswick, of which 143 are considered accidental (NBDNRED 2021). Of the species that regularly occur in the province during at least part of their lifecycle, 12 species are listed as "At Risk", 12 are listed as "May be At Risk", and 48 are considered "Sensitive".

Important Bird Areas

The two closest IBAs to the PDA include: The Shepody Bay West IBA in the Bay of Fundy (NB009) and the Dorchester Cape and Grand Anse IBA in the Bay of Fundy (NB038) (Birds Canada 2022a; 2022b), the closest of which is approximately 40 km away. The habitat in this area consists of intertidal mud flats, sand and gravel beaches, and a rocky cape in the Dorchester IBA (Birds Canada 2022a; 2022b). With the high tides in the Bay of Fundy, it creates a large, open area for shorebirds to forage for invertebrates, in particular the mud shrimp (*Corophium volutator*). These areas are particularly important for shorebirds, including Semipalmated Sandpipers (*Calidris pusilla*) during their fall migration, Dunlin (*Calidris alpine*), and significant numbers of Semipalmated Plovers (*Charadrius semipalmatus*). Other species that use these areas for an important stopover during migration include Short-billed Dowitchers (*Limnodromus griseus*), Least Sandpipers (*Calidris minutilla*), White-rumped Sandpipers (*Calidris fuscicollis*), and Red Knots (*Calidris canutus rufa*), which are listed as Endangered pursuant to SARA, NB SARA, and COSEWIC (Birds Canada 2022a; 2022b).

AC CDC Species at Risk Database Review

A review of the AC CDC data as compiled in a site-specific report (AC CDC 2022) indicated that there were 15 records of 10 vertebrate SAR or SOCC historically observed within 5 km of the PDA. Of these species, eight are avian species. Of these avian species, two are considered SAR, and the remainder are considered SOCC. The two avian SAR include one “location sensitive” bird species (Bald Eagle). The historical observations of SAR or SOCC did not fall within the PDA. The SAR and SOCC identified by the AC CDC as having been historically observed within 5 km of the Project site, as well as their habitat requirements and potential to occur within the PDA, is discussed in **Table 5.6.1**, below.

Table 5.6.1: Bird Species at Risk and Species of Conservation Concern Historically Observed within 5 km of the Project (AC CDC 2022)

Species	Status*	Habitat	Potential to Occur in Project Area
Bald Eagle (*Haliaeetus leucocephalus*)	**NB SARA**: Endangered **S-Rank:** S4	Typically nest in forested areas adjacent to large bodies of water, staying away from heavily developed areas when possible. However, Bald Eagles are tolerant of human activity when foraging. During winter, they are often found in areas which have access to open water (Armstrong 2014).	Based on the proximity of the PDA to the North and Petitcodiac River and the presence of forested areas within the PDA, it is possible that this species may use the PDA for foraging purposes or occur within the PDA incidentally. The PDA does not offer preferential habitat for this species; however, this species was noted within the PDA during the 2022-point counts.
Barn Swallow (*Hirundo rustica*)	**COSEWIC:** Special Concern **SARA:** Threatened **NB SARA**: Threatened **S-Rank:** S2B	Typically nest on human-made structures such as abandoned buildings or barns and forages in open areas (COSEWIC 2011).	The species may use the PDA for foraging purposes; however, the PDA does not offer preferential habitat for this species.
Purple Martin (*Progne subis*)	**S-Rank:** S1B	Purple Martins prefer semi-open areas, including in urban areas such as gardens and fields and usually nest in human-made structures (Burrows 2002). They are aerial insectivores so they mostly forage in flight.	**Possible** - the PDA includes habitat types such as fields and semi-open areas; however, there are not many options for nesting for the Purple Martin within the PDA.

Species	Status*	Habitat	Potential to Occur in Project Area
Vesper Sparrow (*Pooecetes gramineus*)	**S-Rank:** S2B	Open fields including or bordered by shrubs, semi-open grasslands or shrublands, agricultural areas, conifer plantations, and shrubby or scrubby gravel pits (Burrows 2002).	**Possible -** may be found in the fallow fields or fallow field wetland habitat types within the PDA.
Northern Shoveler (*Spatula clypeata*)	**S-Rank:** S3B	Bogs and lakes with muddy bottoms, marshes, open to semi-open areas (Burrows 2002).	**Possible** - the PDA does not contain much of the Northern Shovelers preferred habitat, aside from a few of the small wetlands formed from the karst topography.
Killdeer (*Charadrius vociferus*)	**S-Rank:** S3B	A variety of habitats including any open habitat types, both urban and rural, at a distance from water (Burrows 2002).	**Probable -** this species was observed during point counts within the PDA.
Rose-breasted Grosbeak (*Pheucticus ludovicianus*)	**S-Rank:** S3B	Mixed and deciduous forests with shrubs and/or second growth during breeding; parks, gardens, and woodlots during migration (Burrows 2002).	**Possible** - may be found within the mixed and deciduous forests remaining on-site.
Spotted Sandpiper (*Actitis macularius*)	**S-Rank:** S3S4B, S4M	Any type of wet habitat: ranging from ditches to marshes to rivers, beaches and shores, wetlands, and occasionally cultivated fields (Burrows 2002).	**Probable** - this species was observed within the LAA during field surveys.

Notes:

S1: extremely rare in province; S2: rare in province; S3: uncommon in province; S4: widespread, common and apparently secure in province; S5: widespread, abundant and demonstrably secure in province S#S# = a numeric range rank used to indicate any range of uncertainty about the status of the species or community. B= Breeding, N = Nonbreeding, M = Migrant, U = Unrankable. (AC CDC 2022)

Environment and Climate Change Canada (ECCC) provides general avoidance information for migratory birds, including regional nesting periods during which most migratory bird species covered under the MBCA breed. The PDA is located in Breeding Zone C3, where most migratory birds breed from April 8 to August 28 each year (ECCC 2018); however, it is noted that some avian species nest outside of this period, including corvids, crossbills, owls and waxwings.

Bird surveys were performed on-site by experienced bird specialists skilled at identifying birds by song, call, and sight. The surveys were conducted on May 10 and July 22, 2022. Breeding bird surveys were conducted using point count survey methods based on the standard North American Breeding Bird Survey Protocol (NABBS 2018). Point count locations were chosen systematically within the assessment area to cover the entire PDA as well as to be representative of the different habitat types on-site. A total of 10-point count locations (PC#) were selected **(Table 5.6.2**; **Figure 5.6.1**). Point counts are spaced at least 250 m apart. PC 1-5 were sampled twice within the breeding season, and PC 6-10 were sampled once during the breeding season. The total number of individuals detected (i.e., heard or seen) during the ten-minute observation period were recorded at each point, along with the time of day, weather conditions, and approximate distance to the bird.

Table 5.6.2: Coordinates and Habitat Description of Point Count Locations

Point	Latitude	Longitude	Habitat Description
Point Count 1	45.937981	-65.219096	Open field to the southeast, mixedwood patch to the south (hardwood and cedar), and forested swamp to the north.
Point Count 2	45.93505	-65.2207	Clearcut - Eastern white cedar/trembling aspen with white birch. Near wetland to the south/southwest.
Point Count 3	45.933662	-65.22518	Cedar/Large-tooth aspen stand with white birch and balsam fir. Cutblock to the east (also wetland); field to the southeast.
Point Count 4	45.936697	-65.22544	Mixed-wood to the north; cutblock to the south.
Point Count 5	45.938215	-65.222307	On a ridge within PDA with large Eastern white pine and snags. Adjacent to a field to the north and cutblock to the south.
Point Count 6	45.935408	-65.214606	Edge of field and riparian wetland.
Point Count 7	45.933046	-65.219275	Edge of field, conifers and riparian wetland.
Point Count 8	45.930773	-65.222114	Edge of riparian wetland (WL2) and fallow fields.
Point Count 9	45.93301	-65.212895	Conifer-dominated drainage.
Point Count 10	45.929995	-65.218881	Old field forest, adjacent to a shrubby drainage.

The results of the avian surveys conducted within the PDA are summarized below.

During the 2022 avian surveys, a total of 262 individual birds of 44 different species were recorded throughout the PDA/LAA. Refer to **Appendix E** for detailed observation data tables. In total, 18 resident and migrant bird species were observed during the May 10, 2022 point count event (PC 1-5). The most common species observed included:

- **Black-capped Chickadee (*Poecile atricapillus*):** very common resident associated with diverse forest types and feeders;
- **White-throated Sparrow (*Zonotrichia albicollis*):** very common summer resident and migrant tolerant of a wide range of habitats; and,
- **Common Raven (*Corvus corax*):** common year-round resident with a wide variety of habitats (Burrows 2002). There were numerous common ravens near and within PDA during the summer 2022 field surveys. They were possibly feeding on carrion from a roadkill dump site or something similar.

During the May 10, 2022 spring survey event, no SAR or SOCC were observed within the PDA.

In total, 41 resident and migrant bird species were observed during the July 20, 2022 point count event (PC 1-10). The most common species observed included:

- **Black-capped Chickadee (*Poecile atricapillus*):** very common resident associated with diverse forest types and feeders;
- **Common Raven (*Corvus corax*):** common year-round resident with a wide variety of habitats
- **American Robin (*Turdus migratorius*):** very common summer resident and migrant associated with a variety of habitats and is an early migrant;
- **Red-eyed Vireo (*Vireo olivaceus*):** common to very common migrant that breeds in New Brunswick that prefers deciduous woods and trees (including urban parks).
- **American Crow (*Corvus brachyrhynchos*):** abundant resident with a noticeable winter migration found in a variety of mostly urban habitats.

During the summer survey event, two SAR, including Bald Eagle and Eastern Wood-pewee (*Contopus virens*), and one SOCC, Killdeer (*Charadrius vociferus*), were observed within the PDA. In addition to the point counts, one SAR and one SOCC were observed incidentally during the July field surveys, including Eastern Wood-pewee and Spotted Sandpiper (*Actitis macularius*). Information about the habitat and conservation ranking of Bald Eagles and Spotted Sandpiper are outlined above in **Table 5.6.1**. Eastern Wood-pewees are most often associated with the mid-canopy layer of forest clearings and edges of deciduous and mixed forests. They are most abundant in forest stands of intermediate age and in mature stands with little understory vegetation. During migration, a variety of habitats are used, including forest edges and early successional clearings (COSEWIC 2012).

5.6.2.2 Mammals

NBDNRED's General Status of Wild Species (NBDNRED 2022) reports that there are 52 species of mammals known to occur within New Brunswick, and an additional seven which are extinct, extirpated or unverified. Of these 52 species, Canada lynx (*Lynx canadensis*) is listed as Endangered under the federal SARA and NB SARA, Gaspé shrew (*Sorex gaspensis*) is listed as Special Concern under Schedule 3 of SARA, and three bat species are listed as Endangered on Schedule 1 of SARA, including the little brown bat (little myotis; *Myotis lucifugus*), northern long-eared bat (northern myotis; *Myotis septentrionalis*), and Eastern pipistrelle (tri-coloured bat; *Perimyotis subflavus*).

A review of the AC CDC database (AC CDC 2022) indicated that there are no records of federally or provincially protected mammals, and that no hibernaculum has been reported to have been historically observed within 5 km of the PDA. The AC CDC report does mention historical observations of Eastern cougar (*Puma concolor* pop. 1); however, the species is not currently known to have a population within New Brunswick. The PDA does not provide suitable deer wintering habitat due to the limited amount of canopy cover throughout most of the property.

Incidental observations of mammals recorded during 2022 field surveys are listed below (**Figure 5.6.1**):

- White-tailed deer (*Odocoileus virginianus*) tracks and fur, and direct observation of a doe and two fawns;
- Northern racoon (*Procyon lotor*) tracks;
- Moose (*Alces alces*);
- Eastern coyote (*Canis latrans*) tracks and direct observation; and,
- American beaver (*Castor canadensis*) fresh gnaws on wood.

5.6.2.3 Invertebrates

A review of the AC CDC database (AC CDC 2022) indicated that there are historical records of one insect species within 5 km of the PDA, greenish blue (*Icaricia saepiolus*), a butterfly. Greenish blues are more common on the west coast, and there are few detailed records on the east coast (mostly historical observations). Greenish blues prefer bogs, riparian areas, open fields and meadows, roadsides, and open forests (BMONA 2022). Caterpillar hosts are clovers, and adults feed on nectar from wildflowers, including clovers (BMONA 2022).

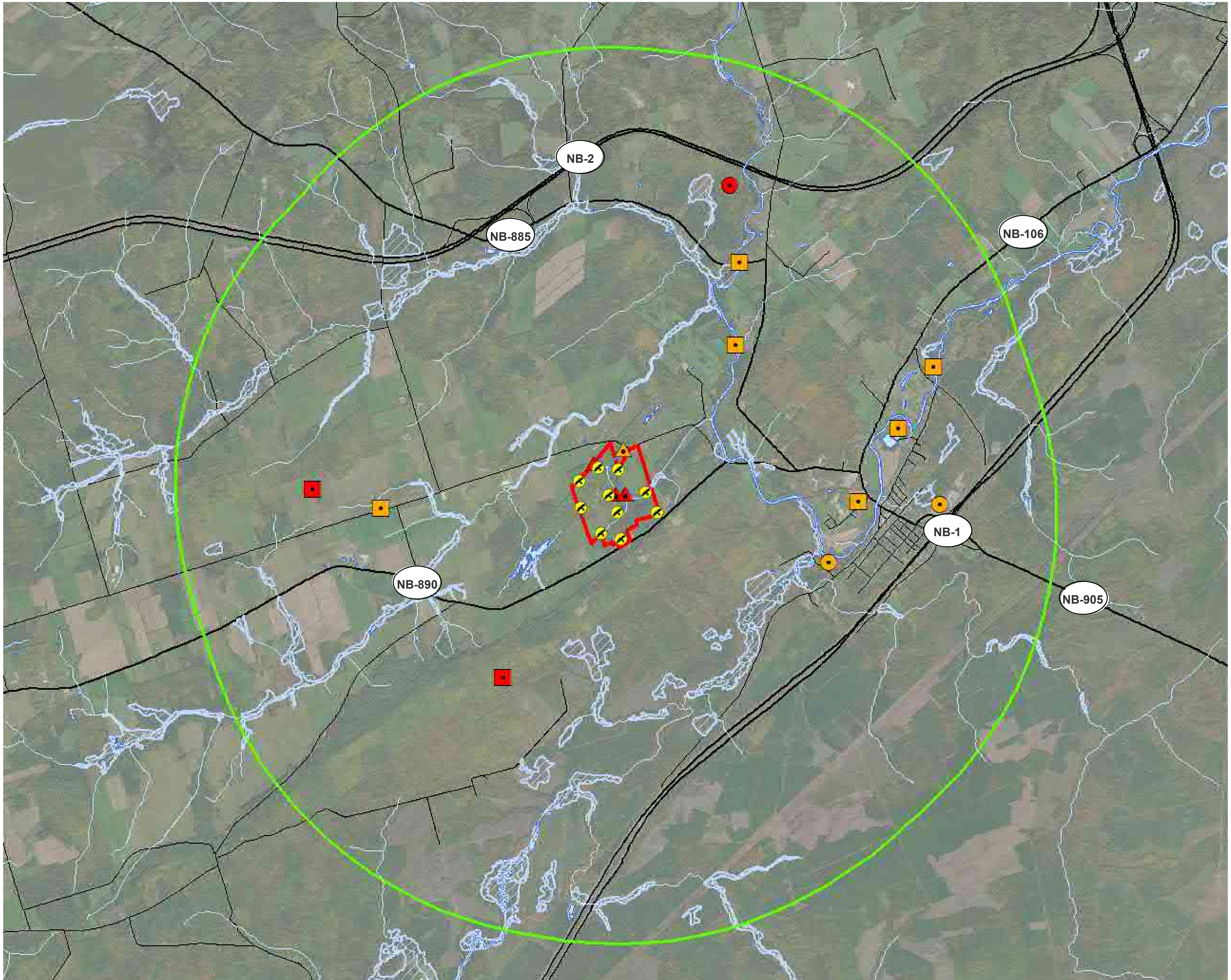
During the 2022 field surveys, one SAR, a monarch (*Danaus plexippus*), was observed in the fallow field habitat within the PDA. Although adult monarchs typically breed in southern USA or Mexico, while they are in Canada, they feed solely on milkweed (*Asclepias*) and lay their eggs on the underside of the milkweed leaves (COSEWIC 2016).

5.6.2.4 Herptiles

NBDNRED's General Status of Wild Species database (NBDNRED 2022) reports that there are 7 reptile and 16 amphibian species known to occur in New Brunswick. Of these species, one (wood turtle; *Glyptemys insculpta*) is considered to be At Risk and one (dusky salamander; *Desmognathus fuscus*) is considered "Sensitive". Wood turtles and snapping turtles (*Chelydra serpentina*) are listed under NBSARA and SARA.

A review of the AC CDC database (AC CDC 2022) indicated that there are historical records of wood turtles within 5 km of the Project site. Though they are a location-sensitive species and exact locations are not known, it is likely that they have been observed on the larger watercourses in the area (i.e., the Petitcodiac River). No turtle species or evidence of turtle presence was observed during 2022 field visits, and the habitat within the PDA is not suitable for wood turtles.

Green frogs (*Rana clamitans*), American toads (*Anaxyrus americanus*), and wood frog (*Rana sylvatica*) were incidentally observed within the PDA during the July 2022 field visits.



HAMMOND RIVER HOLDINGS LIMITED
PROPOSED GLENVALE GYPSUM QUARRY

HISTORICAL RECORDS OF WILDLIFE SAR SOCC AND BIOLOGICALLY SIGNIFICANT SITES WITHIN 5 KM OF THE PDA
FIGURE 5.6.1

- Bird Point Count
- Species At Risk, Birds, Field Identified
- Species Of Conservation Concern, Birds, Field Identified
- Species At Risk, Vertebrate
- Species Of Conservation Concern, Vertebrate
- Species At Risk, Invertebrate
- Species Of Conservation Concern, Invertebrate
- Highway
- Road
- Watercourse
- Project Development Area
- Search Radius 5km
- Waterbodies
- Wetland (NBDELG 2021)

0 250 500 1,000 Meters

SCALE 1:47,235

N W E S

MAP DRAWING INFORMATION:
DATA PROVIDED BY DILLON CONSULTING LIMITED, CANVEC
SERVICE LAYER CREDITS: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), SWISS TOPO, OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

MAP CREATED BY: RP
MAP CHECKED BY: JO
MAP PROJECTION: NAD_1983_CSRS_NEW_BRUNSWICK_STEREOGRAPHIC

DILLON CONSULTING

PROJECT: 22-4280
STATUS: FINAL
DATE: 2022-09-21

FILE LOCATION: K:\2022\224280\Product\Client\Glenvale\Figure 5.6.1 Historical Records of Wildlife SAR SOCC and Biologically Significant Sites within 5 km of the PDA.mxd

5.6.2.5 Environmentally Sensitive Areas

The site-specific AC CDC report (AC CDC 2022) was obtained for the Project area that provides historical flora and fauna species occurrence, as well as environmentally sensitive or managed areas within 5 km of the PDA's centre point. According to the AC CDC (2022) report, there are two biologically significant areas within 5 km of the PDA. This includes the Mannhurst-kinnear Settlement Roadside Environmentally Sensitive Area (ESA) and the Hillgrove Karst ESA. There are also no provincially-identified deer wintering areas within the PDA or LAA (NBDELG 2022d). The PDA does not provide identified unique or limited habitat and is not located within a defined ESA or other provincially regulated or protected area.

5.6.3 Environmental Effects Assessment

As part of the desktop assessment, the habitat requirements of wildlife species identified as potentially occurring within and/or near the PDA were compared to the range of environmental conditions within the PDA to determine if suitable habitat was present for these taxa. Knowledge of the habitats present within the Project area was determined through an interpretation of aerial photography, topographic and geological mapping, as well as information obtained through field reconnaissance efforts (**Section 5.5**). In instances where appropriate habitat was present for a particular species, that taxon was considered to be potentially present in the Project area, mitigation identified and potential impacts assessed.

5.6.3.1 Potential Effects

A number of activities (i.e., vegetation clearing, grubbing, blasting) related to the Project have the potential to interact with wildlife and wildlife habitat. Potential effects on wildlife include direct mortality, habitat loss, and fragmentation. These potential effects are discussed in this section.

Migratory Birds

The primary possible effects to birds due to the proposed Project development include habitat loss and fragmentation, destruction of nests, direct mortality due to collision, and noise disturbance. The purpose of the desktop review and reconnaissance field work aimed to refine constraints mapping by identifying protected species, habitats, or features (such as a colony tree or raptor nest) to confirm effective mitigation during construction activities in order to be compliant with federal and provincial legislation.

The Project may interact with birds and bird habitat in the following ways:

- Construction activities may alter or destroy migratory bird habitat;
- Activities may destroy or alter habitat for bird SAR or SOCC;
- Noise from Project activities may deter birds from migrating into and using the Project area;

- Vegetation clearing and grubbing activities may destroy bird nests and breeding habitat (including SAR/SOCC), and result in habitat fragmentation;
- Noise from Project activities may result in the abandonment of nests or increased rates of predation and exposure of hatchlings and eggs during temporary abandonment; and,
- There is the potential for Bank Swallows to establish colonies in vertical banks or areas of stockpiled soils composed of sandy material and to be directly disturbed by Project activities.

In addition, the operation of the Project may result in sensory disturbance to, and avoidance by, birds due to noise and human activity, and incidental bird collisions with vehicles travelling on the new roads.

Mammals (including Bats)

The Project may interact with wildlife (fauna) and their habitat in the following ways:

- Clearing and grubbing of vegetation (habitat) during construction will cause a change in vegetation (flora) quality and/or quantity (i.e., a disturbance to wildlife habitat);
- Although much of the PDA has already been cleared for logging purposes, the PDA will cause loss of immature (and limited mature) vegetation that provide habitat for wildlife;
- Disturbance from vehicles and construction equipment may cause wildlife avoidance or disruption of wildlife activity (such as breeding and/or feeding);
- Noise, dust, combustion fuel emissions, and vibration may cause a disturbance to wildlife species during the Project;
- Mobile equipment use during the construction or operation activities may cause direct injury or death of wildlife, particularly to small wildlife such as rodents and shrews, through collisions or destruction of dens and food sources;
- Medium and large sized mammals are unlikely to suffer direct mortality from Project activities as they would flee the area in response to human presence and noise. However, such avoidance of behaviour could result in changes to normal movements, migrations, and other life cycle processes; and,
- Following vegetation clearing, there will be local habitat fragmentation while the quarry is operational, making it difficult for mammals to move from one side of the quarry to the other due to lack of cover and increased risk of predation.

In addition, the operation of the Project may result in wildlife encounters, sensory disturbance to and avoidance by wildlife due to noise and human activity, and incidental wildlife collisions.

Herptiles

The Project may interact with herptiles and their habitat in the following ways:

- Following vegetation clearing, there will be local habitat fragmentation while the quarry is operational, making it difficult for herptiles to move from one side of the quarry to the other due to lack of cover and increased risk of predation; and,
- Loss of foraging habitat may occur from wetland alterations, should they be used for such purposes.

It is possible (though unlikely) that wood turtles and snapping turtles could wander upstream along tributaries from the Petitcodiac River to foraging areas at or near the Project area during the summer season. The main threat to these species is from vehicular collisions which affects adult survivorship, which in turn greatly influences population sizes.

5.6.3.2 Mitigation

The following mitigation measures are planned to reduce environmental effects on wildlife and wildlife habitat.

Migratory Birds

- Clearing and grubbing activities will be scheduled to the extent possible outside of the normal breeding bird and migratory bird season (April 8 to August 28 for nesting zone C3) so that eggs and flightless young are not inadvertently harassed or destroyed. At a minimum, if complete avoidance of these activities during the specified timeframe is not feasible, nest searches will be undertaken by a qualified biologist and avoidance setbacks will be established around active nests. Nest searches will only be completed following consultation with Environment and Climate Change Canada (ECCC);
- If there is a delay between clearing and operational activities such that Project operations are initiated during the breeding season, nest surveys will be conducted by experienced biologist or forester for the purpose of determining the presence and activities of birds, such as the Common Nighthawk, which are known to target cleared areas for nesting purposes;
- On-site workers will receive training and reference material that will help them identify species that could be attracted to habitats created by Project operations (e.g., Common Nighthawk and Bank Swallow). If workers encounter birds that they suspect may be nesting within the PDA, a biologist will be contacted to determine whether nesting is occurring and to locate the nest. Note: nests should not be flagged since this increases the probability of predation;
- If a nest is found within the PDA, an appropriate setback will be established around the nest in which humans' activities will be restricted until the young fledge and leave the area or until the nest naturally fails; and,

- If a SAR is encountered, contact will be made to a Species at Risk Biologist at NBDNRED at (506) 453-5873 or by email.

Mammals (including Bats)

- Because of past forestry activities throughout the PDA, and the residential nature of the land use surrounding the PDA, it is unlikely that species particularly sensitive to human activities currently reside in the immediate Project area.

Herptiles

- There is not suitable habitat for herptile SAR in the PDA, and most suitable habitat is downstream of the Project (i.e., the Petitcodiac River).

5.6.3.3 Characterization of Residual Effects

Although much of the PDA has already been cleared for logging purposes, development of the Project will result in vegetation clearing and the loss of some immature and mature vegetation in the PDA. Although the vegetation may provide habitat for wildlife species, the Project is located within an area recently clear cut for forestry purposes, and as such, the habitat offered by the vegetation to be cut is not likely preferred by most wildlife species. Further, there exists ample vegetation and forested land in proximity to the Project for wildlife species to use as higher value habitat than that affected by the Project. Due to the residential nature of the area, there are also not expected to be species sensitive to human activities inhabiting the PDA.

Other than for wood turtles, AC CDC records indicate that no mammal SAR have been historically observed within 5 km of the PDA; however, wood turtles were not observed by Dillon biologists during the July 2022 field surveys, and the habitat within the PDA is not ideal habitat for wood turtles. Two bird SAR, Eastern Wood-pewee and Bald Eagle, were observed during the point count bird surveys in July 2022. Bald Eagles likely forage along the Petitcodiac River and are unlikely to be affected by the Project activities, though they may nest in the tall Eastern white pine (*Pinus strobus*) trees on the eastern side of the PDA. Eastern Wood-pewees prefer to inhabit open lands, including woodland openings and edges (Burrows 2002), which is characteristic of the PDA.

Project activities are likely to result in sensory disturbance to wildlife and thus wildlife is likely to avoid the areas where Project activities are to take place, thereby limiting the potential for wildlife encounters, injury, or mortality of wildlife species. Operation of the site access road and internal roads as well as other activities (e.g., crushing) will result in some noise and likely avoidance by wildlife. Given the relatively limited area of disturbance associated with the Project, and the environmental setting of the Project including being largely on previously disturbed land, substantive interactions between the Project and wildlife and wildlife habitat are not anticipated.

Although the vegetation (and wetlands) in the PDA may provide habitat for bird species, including SAR (e.g., Eastern Wood-pewee), the Project is located in a larger surrounding area with ample vegetation and forested land for bird species to use as higher value habitat than that affected by the Project. Development of the Project is likely to result in sensory disturbance to birds and thus birds are likely to avoid the areas where construction or operation activities are to take place, thereby limiting the potential for injury or mortality of bird species. Operation of the new access road and quarry and related operations will result in some noise and likely avoidance by birds. Given the relatively limited area of disturbance associated with the Project, the environmental setting, past use of the Project footprint, and implementation of the mitigation measures outlined in **Section 5.6.3.2**, substantive interactions between the Project and birds and bird habitat are not anticipated.

Following the completion of the operation of the Project, the PDA will be reclaimed and restored to as near natural conditions as possible, thereby returning the Project site to a state where it can, over time, provide habitat for wildlife species.

5.6.4 Summary

Assuming application of the mitigation measures described above, including conducting vegetation clearing activities outside of the ECCC recommended timing window for the Project location to facilitate compliance with the MBCA, and a worker education program for identifying SAR and SOCC, the residual environmental effects of the Project on wildlife and wildlife habitat during each phase of the Project are rated not significant, with a high level of confidence. Based on a consideration of existing conditions and likely residual effects of the Project, no monitoring programs are currently recommended for wildlife and wildlife habitat.

5.7 Agricultural Land and Livestock

The potential environmental effects of the Project on the agricultural land and livestock are assessed in this section.

5.7.1 Scope of the VC

The agricultural land and livestock valued component (VC) includes farm land, blueberry fields, crop fields (ex. hay fields), cattle, horses, pigs, sheep, bees, and other livestock. These specific components were identified during field reconnaissance surveys near the PDA. Agricultural land and livestock was selected as a VC because of potential interactions between the VC and proposed Project activities. The field reconnaissance identified numerous livestock (e.g., bees, cattle, horses, and pigs) and agricultural lands (e.g., farm fields and blueberry fields) in the vicinity of the Project.

Background information sources reviewed to identify and assess agricultural land and livestock presence at the Project site included publicly-available online mapping (I.e., aerial maps). Information gathered during the desktop assessment was confirmed via visual surveys during field reconnaissance activities.

5.7.1.1 Temporal Boundaries

The temporal boundaries for the Project include the following:

- **Construction**: extending for a period of approximately four months, anticipated to begin in the fourth quarter (Fall) of 2023 (subject to the receipt of all approvals and permits required for the Project);
- **Operation**: beginning in approximately the first quarter of 2024, and lasting for approximately 10 years or until the mineral resource has been depleted; and,
- **Reclamation and closure**: to be initiated following the completion of operations at the site, with decommissioning and reclamation of the surface facilities at the site for an anticipated duration of six months following operation.

5.7.1.2 Spatial Boundaries

The Project development area (PDA) is defined as the area of physical disturbance associated with construction and operation of the Project. Specifically, the PDA consists of an area of approximately 85 ha (i.e., conservatively assumed to be the entirety of PIDs 00814160, 70076948, and 70654058) that includes the open pit and all related surface facilities located on the property. The PDA is the area represented by the physical Project footprint.

The local assessment area (LAA) is the maximum anticipated area within which Project-related environmental effects are expected. For agricultural land and livestock, the LAA includes the PDA and areas within approximately 3 km beyond the PDA where Project-related environmental effects could be expected to occur.

5.7.1.3 Significance Threshold

A significant adverse residual environmental effect on agricultural land and livestock is one where animals or crops are sufficiently affected by the Project (e.g., decreased reproduction, milk production from cattle or honey from bee farms).

5.7.2 Existing Conditions

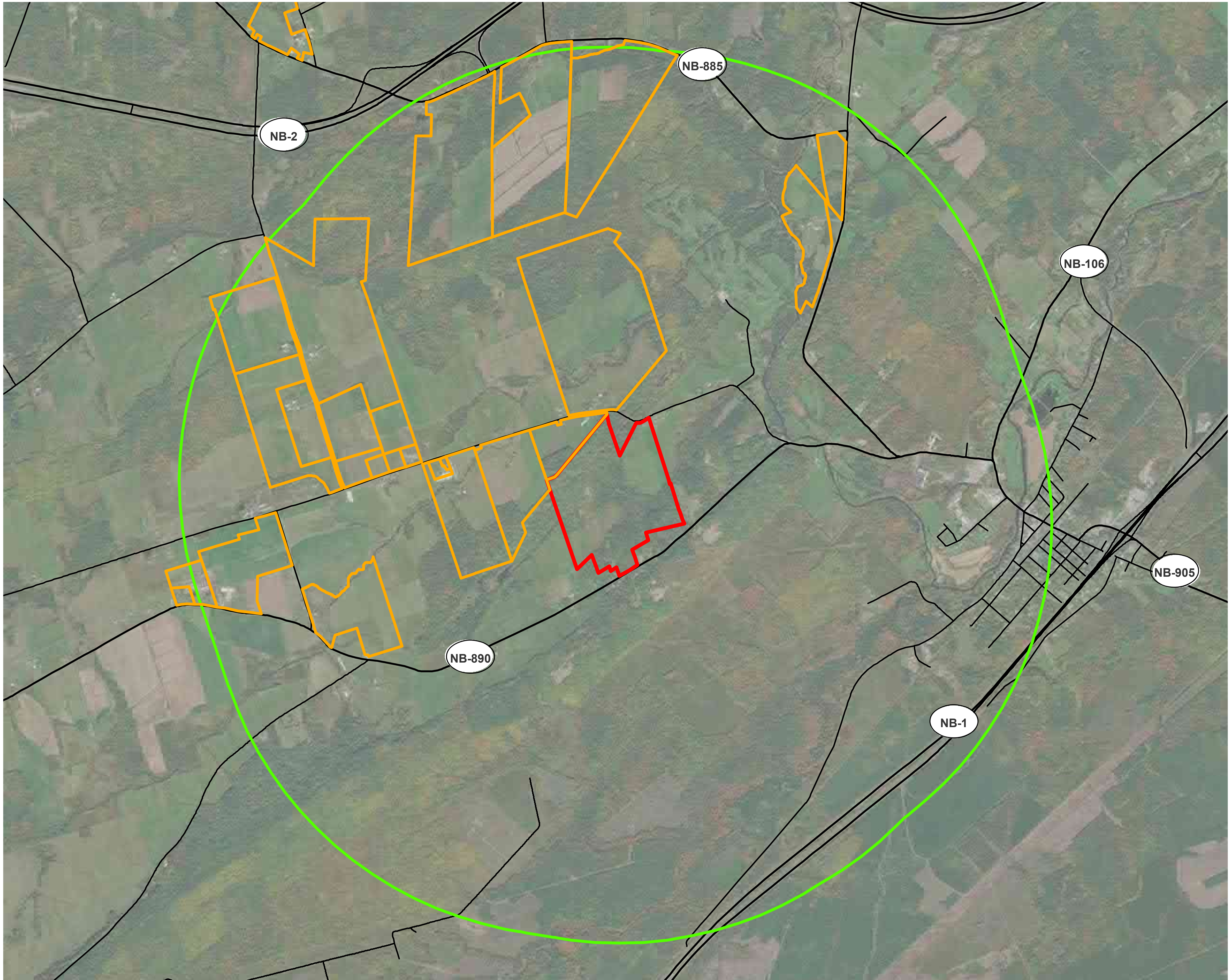
Information regarding the use of the LAA by livestock and presence of agricultural land was derived from provincial mapping (i.e., GeoNB aerial maps and parcel information), as well as field-level reconnaissance surveys. Refer to **Figure 5.7.1** for a depiction of the land parcels within the LAA classified as farmland according to GeoNB.

The desktop assessment was supported by field surveys where Dillon employees conducted visual surveys to identify locations of livestock and agricultural lands (**Figure 5.7.2**). As shown on **Figure 5.7.1** and **Figure 5.7.2**, the PDA is surrounded by agricultural land and livestock, excepting mostly forested properties located south of Route 890. The nearest agricultural lands and livestock border the PDA to the north, west, and east, directly adjacent to the PDA boundary. The quarry layout is the nearest site feature to agricultural lands and livestock at approximately 35 m.

The different types of agricultural lands and livestock encountered during the field surveys include:

- blueberry farms;
- hay fields;
- bee farms;
- cattle;
- horses;
- sheep; and
- pigs.

Cattle and a bee farm were identified nearest to the PDA (see **Figure 5.7.2**).



HAMMOND RIVER HOLDINGS LIMITED
PROPOSED GLENVALE GYPSUM QUARRY

AGRICULTURAL LANDS WITHIN AND NEAR THE LAA
FIGURE 5.7.1

- Highway
- Road
- Identified Agricultural Property
- Project Development
- Search Radius 3km

0 200 400 800 Meters
SCALE 1:30,570
N W E S

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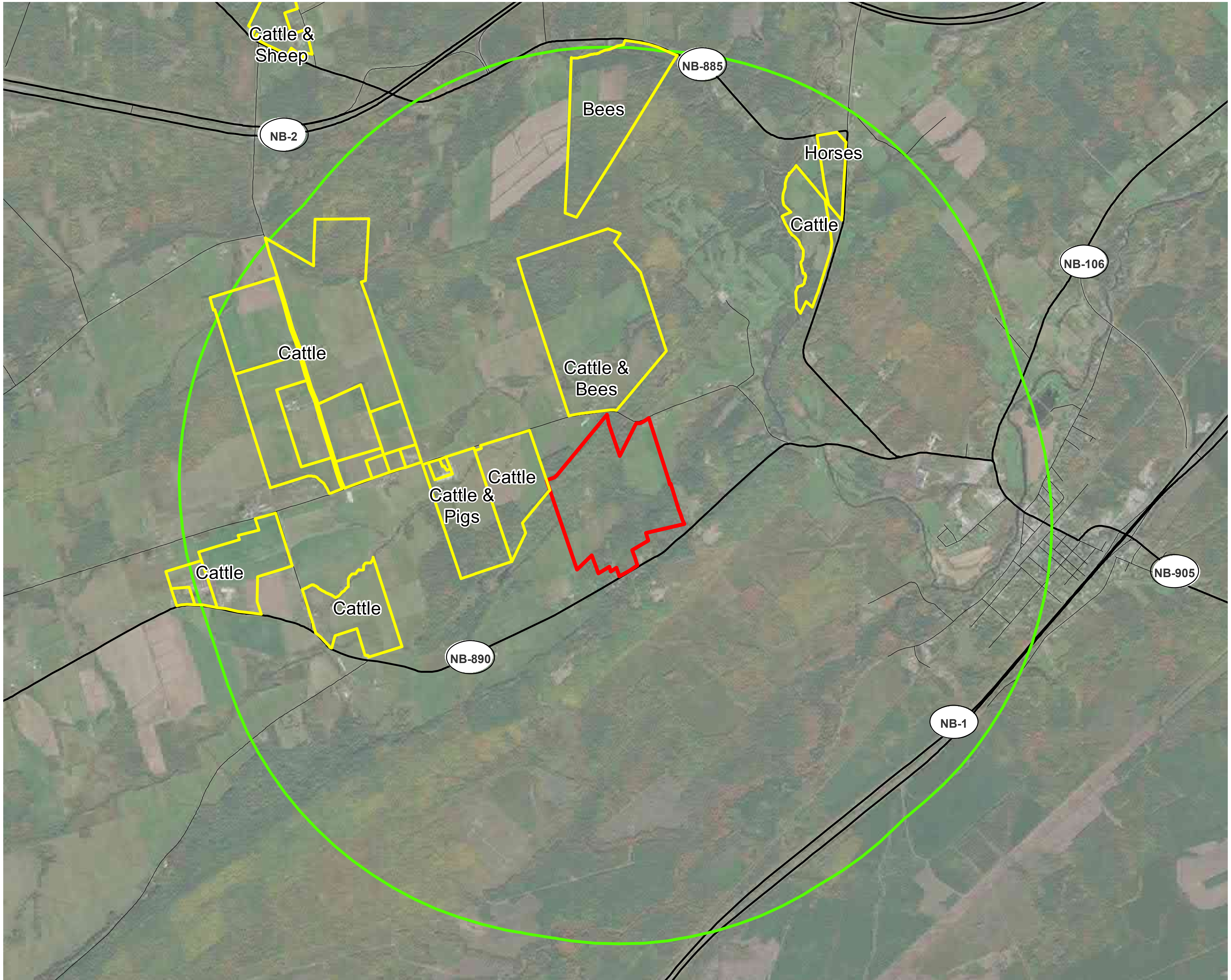
PROJECT: 22-4280
STATUS: FINAL
DATE: 2022-09-21

FILE LOCATION: K:\2022\224280\Product\Client\Glenvale\Figure 5.7.1 Agricultural Lands within and near the LAA.mxd

HAMMOND RIVER HOLDINGS LIMITED
PROPOSED GLENVALE GYPSUM QUARRY

LIVESTOCK WITHIN AND NEAR THE LAA
FIGURE 5.7.2



Legend:
- Highway
- Road
- Identified Agricultural Property
- Project Development Area
- Search Radius 3km

0 200 400 800 Meters

SCALE 1:30,570

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PROJECT: 22-4280
STATUS: FINAL
DATE: 2022-09-21

FILE LOCATION: K:\2022\224280\Product\Client\Glenvale\Figure 5.7.2 Livestock within and near the LAA.mxd

5.7.3 Environmental Effects Assessment

As part of the desktop assessment, the environmental conditions for livestock and agricultural land to support normal farm operations in the LAA were compared to environmental conditions that may arise due to the Project. Knowledge of existing conditions near Project area was determined through an interpretation of aerial photography, online research as well as information obtained through field reconnaissance efforts (**Section 5.7.2**). Effects generated over the lifespan of the Project were determined based on an understanding of the Project components and an examination of other mining projects of similar scope. Where potential effects from the Project are identified, mitigation measures are described and the residual effects after implementation of mitigative measures are characterized.

5.7.3.1 Potential Effects

A number of activities (i.e., vegetation clearing, grubbing, blasting) related to the Project have the potential to interact with agricultural land and livestock. Potential effects of the Project on livestock may include changes in behaviour due to noise and vibration which may affect productivity of the livestock (e.g., milk production in cows and honey production in bee farms). The Project may indirectly affect local agriculture if surface or groundwater resources are adversely affected as a result of Project activities since those water sources may be used for irrigation or livestock consumption. The Project directly affects agricultural land use by occupying the PDA and using those lands for commercial purposes for the duration of the Project. These potential effects are discussed in this section.

The following interactions the Project with agricultural lands and livestock with the Project may also occur:

- Clearing and grubbing or vegetation (habitat) during construction will cause a change in vegetation (flora) quality or quantity (i.e., may cause a decline in food source for bees in nearby bee farms);
- Disturbance from vehicles and construction equipment may cause livestock avoidance or disruption of livestock activity (such as breeding and/or feeding);
- Noise, dust, combustion fuel emissions, and vibration may cause a disturbance to livestock species and crops during the Project;
- Mobile equipment use during the construction or operation activities may cause direct injury or death of bees, through collisions or destruction of food sources;
- Following vegetation clearing, there will be local habitat fragmentation while the quarry is operational, which may make it difficult for bees to move from one side of the quarry to the other due to lack of cover and increased risk of predation; and,
- The operation of the Project may result in sensory disturbance to and avoidance by livestock due to noise and human activity, and incidental bee collisions.

Literary review determined that cattle can tolerate moderate levels of noise of 60 to 90 dBA. Similar tolerances were documented in sheep and pigs as well, with adverse behavioural effects noted at sound levels exposures above 90 dBA (Broucek 2014).

5.7.3.2 Mitigation

Mitigation measures to reduce the environmental effects of the Project on agricultural land and livestock are identified below.

There are agricultural operations and known groundwater or surface water supplies within the LAA that could interact with the Project (**Figure 5.3.1** and **Figure 5.3.2**); an assessment of the environmental effects and the Project design and mitigation measures planned to address Project effects on water resources is provided in **Section 5.3**. The mitigation measures described therein will also reduce the environmental effects of the Project on livestock and agricultural land in terms of water resources.

Environmental effects on livestock and agricultural land due to noise and fugitive emissions are similar to those described in **Section 5.1** and **Section 5.2**.

5.7.3.3 Characterization of Residual Effects

The characterization of residual effects on agricultural land and livestock are encompassed for the most part in **Section 5.2** and **Section 5.3** (atmospheric environment and water resources VCs). The residual effects described in these sections may interact with agricultural lands and livestock.

Characterization of residual effects was updated in the acoustic modelling according to potential nearby livestock receptors. According to the desktop assessment and reconnaissance field surveys, the nearest potential receptor to noise generated by the Project is a parcel directly north of the quarry which was identified as having cattle (refer to **Figure 5.7.1** and **Figure 5.7.2**). The next nearest receptor was a parcel located west of the quarry also identified as containing cattle. The noise modelling followed the same assumptions for equipment uses and locations as in **Section 5.2**, with the exception of the distances to the receptors. Given that cattle would be free to roam the agricultural parcels identified in **Figure 5.7.2**, the distances were calculated from the center of the quarry and stockpiling area to the nearest open field. These approximate distances are as follows:

- Distance from the center of the quarry to livestock receptor 1 (north property): 280 m
- Distance from the center of the quarry to livestock receptor 2 (west property): 380 m
- Distance from the center of the stockpile area to livestock receptor 1 (north property): 490 m
- Distance from the center of the stockpile area to livestock receptor 2 (west property): 500 m

The predicted sound pressure levels at each modelled livestock receptor were mostly below the tolerance level for cattle of 60 to 90 dBA. Levels did not exceed 60 dBA for the construction phase and the worst-case modelling predicted 1-hour Leq (equivalent sound level) at the nearest receptor was 60.6 dBA during the operation phase.

Given the relative distance between Project activities and the nearest livestock receptors, and the experience gained as a result of sound pressure levels and vibration levels measured at the Upham East Gypsum Quarry, blasting activities may result in temporary behavioral changes, lower feed intake, and lower milk yields in cattle. Sound emissions between 95 and 105 dBA were found to lower feed efficiency and decrease milk quantity (Broucek 2014).

Blasting activities will be limited to approximately 25 blasts per year as an annual average (excluding nights, weekends, and statutory holidays), and a communication plan will be developed for residents who wish to be notified. Blasting activities will be monitored using a seismograph to verify noise levels do not exceed provincial standards.

Activities during the reclamation and closure phase are expected to be similar in nature to those occurring during construction (though somewhat in reverse order). Though not specifically quantified for the reclamation and closure phase, noise, and vibration are expected to be similar to, or less than, those could occur during construction. As such, environmental effects on agricultural lands and livestock during the reclamation and closure phase are not expected to be substantive.

5.7.4 Summary

The effects of the Project on agricultural lands and livestock due to demands on water resources, and fugitive dust and emissions from equipment are described in the summaries of **Section 5.2** and **Section 5.3**. To reiterate, the effects are expected to be localized and minimal, using standard and site-specific mitigation as identified. Appropriate mitigative measures will be taken when required so that nuisance dust levels are controlled such that they do not cause an exceedance of ambient air quality standards at the property line or a nuisance at nearby receptors. It is unlikely that emissions will exceed New Brunswick or federal air quality standards beyond the property boundary for the Project.

In light of the above, and in consideration of the nature of the Project, its anticipated environmental effects, and the implementation of mitigation and best practices that are known to reduce environmental effects, the residual environmental effects of the Project on agricultural lands and livestock during each phase of the Project are rated not significant, with a high level of confidence.

5.8 Socioeconomic Environment

The potential environmental effects of the Project on the socioeconomic environment are assessed in this section.

5.8.1 Scope of VC

The Project has the potential to interact with the socioeconomic environment, which includes land and resource use, employment, and the local economy. These potential interactions are of concern to regulatory agencies, non-governmental organizations, Indigenous communities, and the general public because they can have a direct influence on the everyday lives of those living and working in the vicinity of a project.

The main components of the socioeconomic environment are defined as follows.

- Land and resource use refers to current and future uses of public and private land and resources. It includes uses such as industrial, commercial, and residential use, property ownership (including potential nuisance effects), and the use of land and resources for recreational purposes.
- Employment and economy refers to the labour market and availability, employment, employment income, business income, and their aggregate influence on the local, regional and provincial economies.

The scope of this VC includes potential interactions of the Project with residential, agricultural, forestry recreation, and transportation land uses; and the employment and economic conditions. The scope of the assessment is based on applicable regulations and policies, anticipated issues and concerns, existing knowledge of the area, and anticipated potential interactions.

5.8.1.1 Temporal Boundaries

The temporal boundaries for the Project include the following:

- **Construction**: extending for a period of approximately four months, anticipated to begin in the fourth quarter (Fall) of 2023 (subject to the receipt of all approvals and permits required for the Project);
- **Operation**: beginning in approximately the first quarter of 2024, and lasting for approximately 10 years or until the mineral resource has been depleted; and,
- **Reclamation and closure**: to be initiated following the completion of operations at the site, with decommissioning and reclamation of the surface facilities at the site for an anticipated duration of six months following operation.

5.8.1.2 Spatial Boundaries

The Project development area (PDA) is defined as the area of physical disturbance associated with construction and operation of the Project. Specifically, the PDA consists of an area of approximately 85 ha (assumed to make up the PIDS No. 00814160, 70076948, and 70654058) that includes the open pit and all related surface facilities located on the property. The PDA is the area represented by the physical Project footprint.

The local assessment area (LAA) is the maximum anticipated area within which Project-related environmental effects are expected. For the socioeconomic environment, the LAA includes the local communities of Glenvale and Hillgrove. The LAA includes the PDA and adjacent areas along the preferred transportation route where Project-related environmental effects could be expected to occur. The village of Petitcodiac falls just outside of the LAA, located approximately 3 km from the PDA.

5.8.1.3 Significance Threshold

Significance thresholds are defined for a change in land and resource use and a change in employment and economy, as follows.

A significant adverse residual environmental effect of the Project on land and resource use is one where the Project directly results in an uncompensated loss of land-based resource value or permanent change in regional access (current) or future opportunities to develop land-based resources.

A significant adverse residual environmental effect of the Project on employment and the local economy is one that results in a Project-related sustained long-term decreased level in employment and economic activity in the community, region or province. A significant positive residual environmental effect of the Project on employment and the local economy is one that results in a Project-related sustained increased level of employment and economic activity in the community, region, or province.

5.8.2 Existing Conditions

Existing socioeconomic conditions in the LAA are described in this section.

5.8.2.1 Land and Resource Use

The Project is located in the small community of Glenvale, Salisbury Parish, Westmorland County, in Southern New Brunswick. The LAA is a sparsely populated rural community with land use generally focused on residential, forestry, and agricultural uses.

Local Government Structure

There are twelve service regions in New Brunswick directed by Regional Service Commissions (RSC) that are responsible for delivery of local land use planning, building inspection, and solid waste management. Each commission is made up of representatives from the area's incorporated municipalities and unincorporated Local Service Districts (LSDs).

The PDA is located within the Southeast Regional Service Commission, which is comprised of 24 LSDs and 15 municipalities. Refer to **Figure 5.8.1** for an illustration of the boundaries of the Southeast Regional Service Commission. The Project site is located within the LSD of Salisbury.

The local government structure will change in January 2023. The LAA will form part of the Community of Three Rivers. It is assumed that development services and solid waste management will continue to be provided by the Southeast Regional Service Commission. The Commission will also be mandated to provide recreation and economic development services to the new municipality.

Land Use Planning

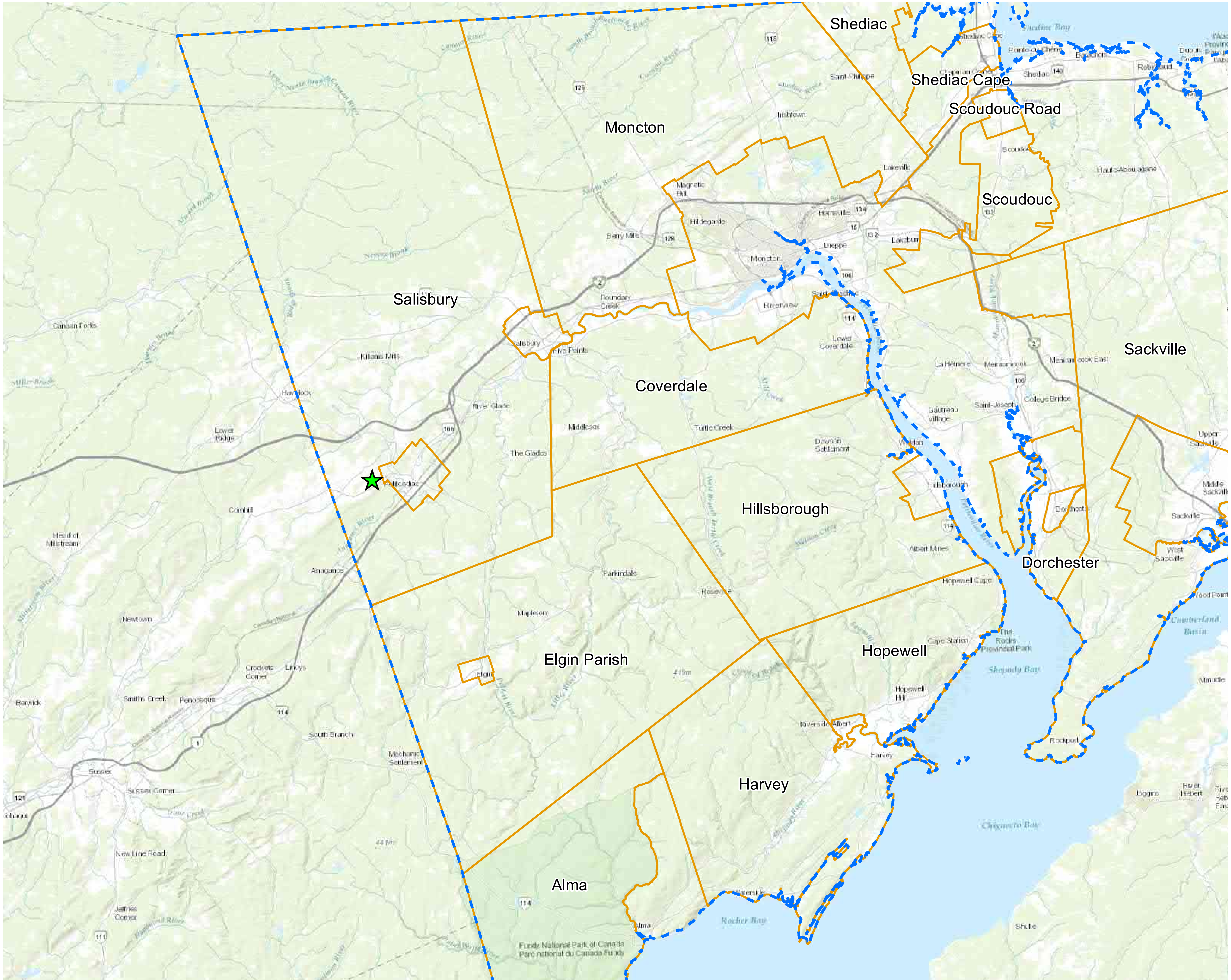
Development in Salisbury Parish is guided by the Westmorland-Albert Planning Area Rural Plan Regulation (WARP). Development projects are also subject to provincial regulations, and permitting and inspections are managed by the Southeast Regional Service Commission. Existing land uses in the LAA are shown in **Figure 5.8.2**.

The PDA is in the Agricultural (A) zone under the WARP. The proposed development is considered a quarry under the WARP. Quarries are not permitted in the A zone. The lands must be rezoned to the Intensive Resource Development zone previous to the issuance of development permits.

A rezoning application was submitted in July 2022. A determination on the application is anticipated before December 2022.

Residential Land Use

Residential land use in the vicinity of the PDA is linear along the main roads, primarily Route 890, Baseline Road, and Buckley Settlement Road. There are three residences to the north, located approximately 200 to 300 m from the expected PDA boundary. There is one residence to the east and six residences to the south that have adjoining PIDs with the PDA; however, the residences are 400 to 700 m away from where the main operations will take place. Statistics Canada's 2021 Census for Salisbury Parish indicates that the number of dwellings occupied by usual residents is 1,353, while the total number of private dwellings is 1,432 (Statistics Canada 2022).



HAMMOND RIVER HOLDINGS LIMITED

PROPOSED GLENVALE GYPSUM QUARRY

REGIONAL SERVICE COMMISSION 7 BOUNDARIES

FIGURE 5.8.1

- Site Location
- Regional Service Commissions (RSC) 7
- Local Service Districts (LSD)

0 1.5 3 6 Kilometers

SCALE 1:300,000

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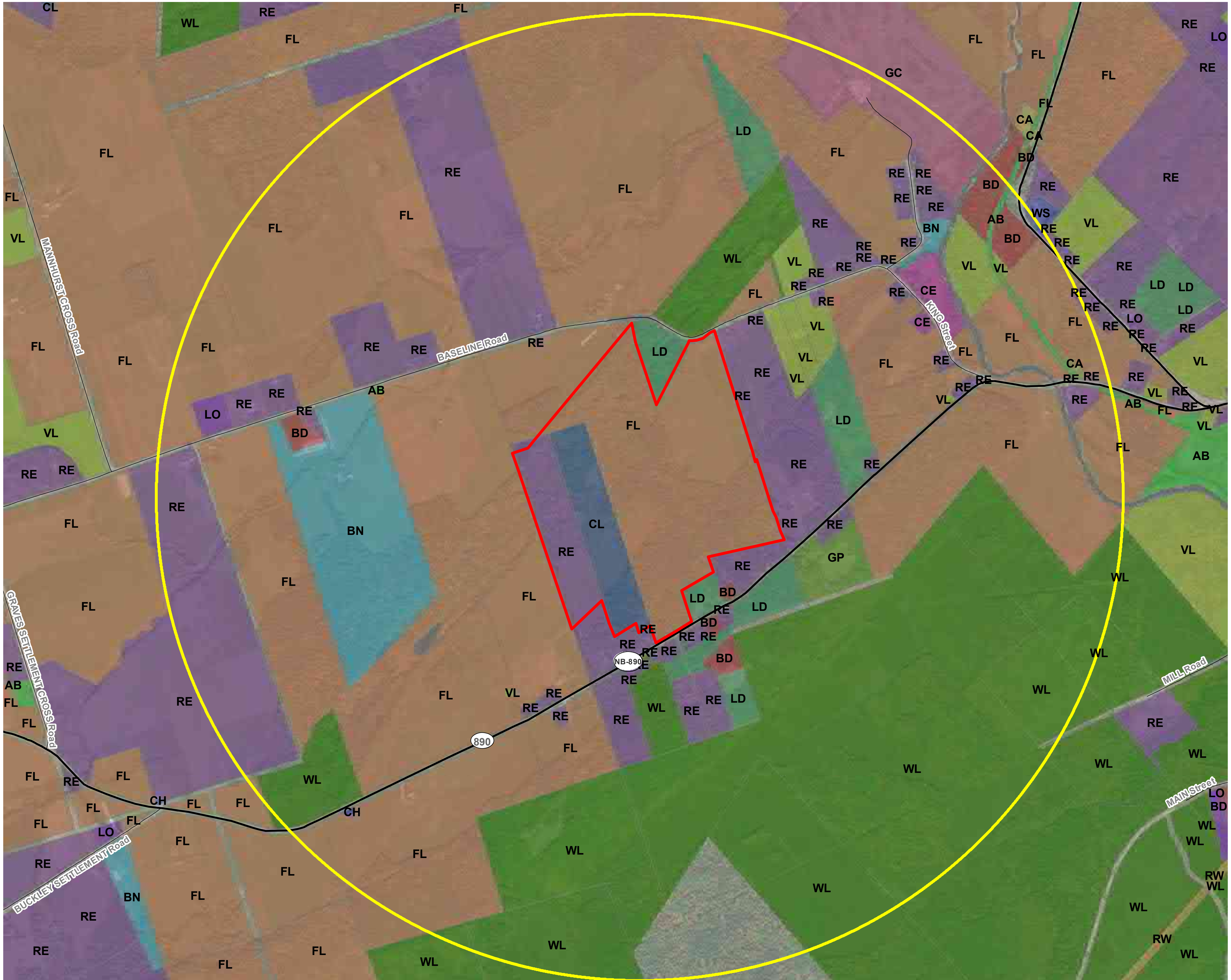
PROJECT: 22-4280
STATUS: FINAL
DATE: 2022-11-29

FILE LOCATION: K:\2022\224280\Product\Client\Glenvale\Figure 5.8.1 Regional Service District.mxd



HAMMOND RIVER HOLDINGS LIMITED
PROPOSED GLENVALE GYPSUM QUARRY

LAND USE IN THE LOCAL ASSESSMENT AREA
FIGURE 5.8.2

Highway	Cleared Land (CL)
Road	Land (LD)
2km Radius	Farmland (FL)
Project Development Area	Golf Club (GC)
Buildings (BD)	Gravel Pit (GP)
Abandoned Property (AB)	Residence (RE)
Church Land (CH)	Lot (LO)
Barn (BN)	Woodland (WL)
Camp (CA)	Railway (RW)
Cemetery (CE)	Vacant lot (VL)
	Welding Shop (WS)

0 100 200 400 Meters
SCALE 1:15,490

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MAP CREATED BY: RP
MAP CHECKED BY: JO
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DILLON CONSULTING

PROJECT: 22-4280
STATUS: FINAL
DATE: 2022-09-21

FILE LOCATION: K:\2022\224280\Product\Client\Glenvale\HarrisonFigures\Glenvale_Figure2_LAA Land Use.mxd

Commercial Land Use

There are three businesses near the LAA, one is a home-based dog training centre business on Route 890 and the others are agricultural businesses along Baseline Road.

Institutional Land Use

A cemetery is located approximately 750 km from the PDA. The Petitcodiac Regional School is located 2.2 km east of the PDA. Other institutional land uses within the general vicinity are limited to local churches and community halls.

Though there are no facilities located in the LAA, policing services are provided by the Royal Canadian Mounted Police (RCMP), with the nearest detachments located in Moncton and Sussex. Emergency medical services are provided by Ambulance New Brunswick with stations in Hampton, Sussex, and St. Martins. Health Services are provided by the Horizon Health Network and the Vitalité Health Network, with the nearest hospitals located in Sussex and Moncton.

Industrial Land Use

Industrial land uses in the general vicinity of the PDA are limited to small scale forestry operations. Details of forestry land uses are described below.

Agricultural Land Use

Agricultural land use is prevalent in the general vicinity of the LAA. Active agricultural sites are evident on adjacent and nearby properties and appear to be primarily pasture and hay fields, with the occasional livestock farm. The PDA is described by the CRM Group as having been partially made up of former agricultural fields, some of which have been reclaimed by forest (CRM Group 2022, p. 28).

Forestry Land and Resource Use

Forestry is an important industry in New Brunswick and occurs to varying degrees throughout the rural regions of the province. The PDA itself has been the subject to forest clearing activities over the past ten years, which is evident on the PDA itself as well as on nearby properties. The CRM Group has confirmed that a large section of the PDA was recently deforested for logging purposes. Wooded areas contained mixed hard- and softwood species, with softwood being dominant. Several stands of dense, immature softwood trees were identified, particularly in the southern portion of the study area. Cedar and Hawthorn were common as planted rows along historic roads and fence lines/property boundaries. Vestigial stands of apple trees were also common throughout the PDA (CRM Group 2022, p. 28).

Recreational Land and Resource Use

The Petitcodiac Valley Golf and Country Club is located approximately 1 km northeast of the PDA. The North River is approximately 920 m east of the PDA. While there is no recreation-related infrastructure within the general vicinity of the PDA, both residents and visitors used the Petitcodiac River for a variety of purposes, including boating, canoeing, and kayaking. These activities largely take place along the portions of the river that are between Moncton and the Bay of Fundy.

The PDA is situated with Wildlife Management Zone 22, and hunting, trapping and snaring are permitted in the area, with the exception of Protected Natural Areas (NBDERD 2017). The Petitcodiac River, as well as the PDA, are located in the Inner Bay of Fundy Recreational Fishing Area (RSA5).

Transportation Land Use

The TransCanada Highway (Route 2) is the primary transportation mode going through Salisbury Parish, connecting residents in the Parish to Moncton, Fredericton, and the remainder of the country. New Brunswick Route 1, connecting drivers to Moncton, Sussex, Hampton, and Saint John also runs through the Parish. Route 112 connects Coles Island, Canaan Forks, Salisbury, and Riverview. The parish is also intersected by secondary routes. Route 905, links the southward communities of Elgin, Midland, Goshen, and Portage Vale, and Route 890 largely serves farming communities between Petitcodiac and Sussex.

The CN Rail Line travels through Salisbury Parish, between Moncton and Saint John, running parallel with New Brunswick Route 1. There is a CN-owned non-operational spur line between Moosehorn Siding (south of Norton) and the former Cassidy Lake Potash mine.

5.8.2.2 Employment and Economy

Population

According to the Statistics Canada 2021 Census Profile for Salisbury Parish Census Subdivision (the smallest census division available for the Project location), the total population in 2021 was 3,375, a slight decrease from 3,388 in 2016. The population density of the parish is 3.9 persons per square kilometre, compared to 10.9 for the province. **Figure 5.8.3** shows the distribution by age category for the 2016 and 2021 census years (Statistics Canada 2017; 2022). The age distribution of people living in Salisbury Parish (**Table 5.8.1**) for the 2021 Census indicates that the largest proportion of the population is in the 55-64 age group, followed by the 45-54 age group. Both of those age groups have decreased between the 2016 and 2021 Census years, while the number of people aged 65 and over have increased (Statistics Canada 2012; 2017).

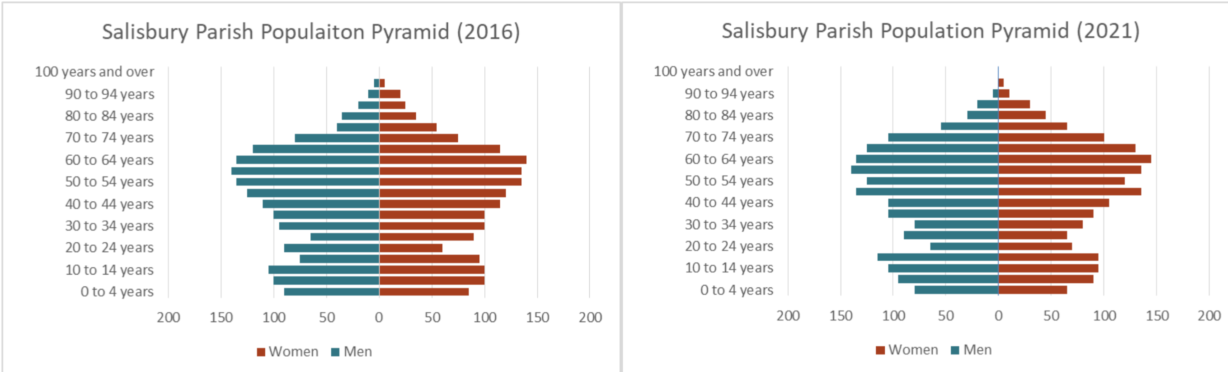

Figure 5.8.3: Salisbury Parish Population Pyramid for 2016 (left) and 2021 (right) (Statistics Canada 2017; Statistics Canada 2022)

Table 5.8.1: Age Group Distribution for Salisbury Parish 2016-2021

Age Group	2016 Census Year	% of Total	2021 Census Year	% of Total	Change 2016-2021 (number)
0-24	900	26.55%	875	25.89%	-25
25-54	1,305	38.50%	1,230	36.39%	-75
55-64	555	16.37%	550	16.27%	-5
65+	630	18.58%	720	21.30%	90
Total	**3,390**		**3,375**		**-15**

Note: Age group totals differ from population totals.
Source: Statistics Canada (2017); Statistics Canada (2022).

Employment and Economy

Compared to the rest of the Province of New Brunswick, Salisbury Parish is specialized in natural resources and trades, transport, and equipment related occupations (**Figure 5.8.4**). Salisbury Parish has a significantly higher percentage of workers in the trades, transport, and equipment related occupations compared to the remainder of the province.

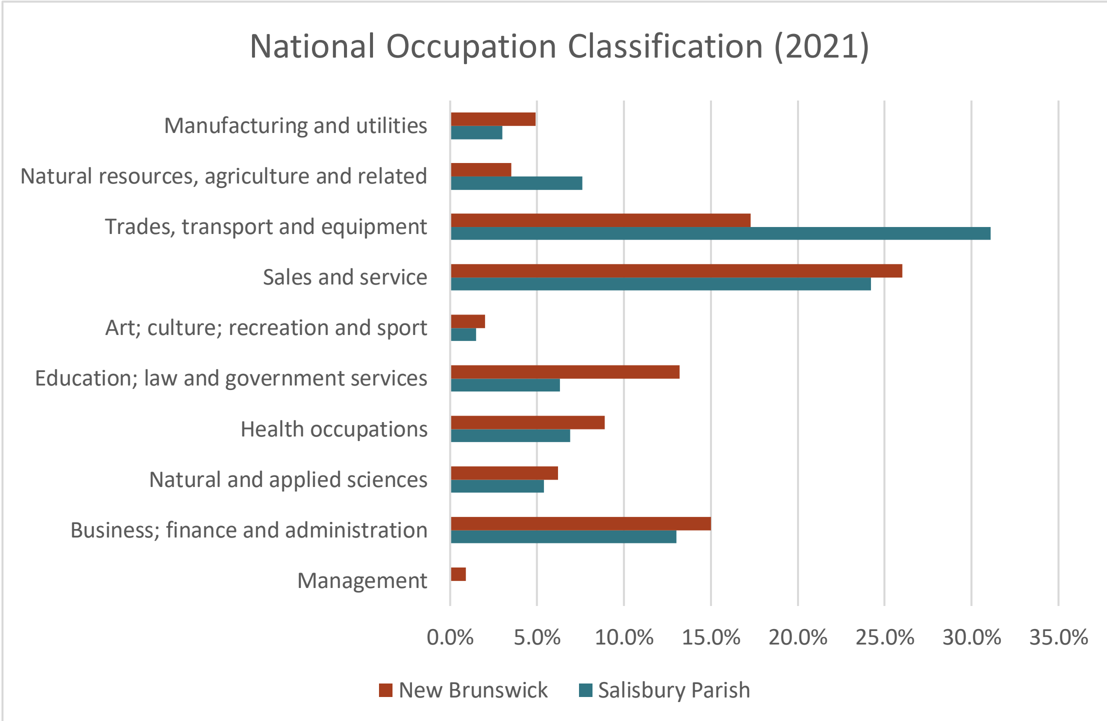

Figure 5.8.4: National Occupation Classification (2016) for Salisbury Parish and all of New Brunswick (Statistics Canada 2021)

The total median income of households in Salisbury Parish was $71,500 during the year 2020 (**Figure 5.8.5)**. This is slightly higher than the provincial numbers, though Parish and provincial incomes are roughly equivalent. The average total income for households in Salisbury Parish is $79,400, which is lower than the provincial average household income of $85,400 (Statistics Canada 2022). Both average and median incomes are included in this report because they produce different numbers which represent the population's income as a whole. The average produces a number which represents the typical Parish resident's income, and is calculated by adding all values together (i.e., the income of each individual in the workforce) and dividing the sum by the total number of people in the labour force. The median income describes the middle value in a list of sorted values, which is useful for determining a single value to represent the typical income in Salisbury Parish, particularly because it is not skewed by outliers (i.e., extreme, infrequent high incomes; or extreme, infrequent low incomes) in the same way that average values can. Analyzing the typical income of residents with both measurements provides well-rounded insight into the incomes of the Parish as a whole.

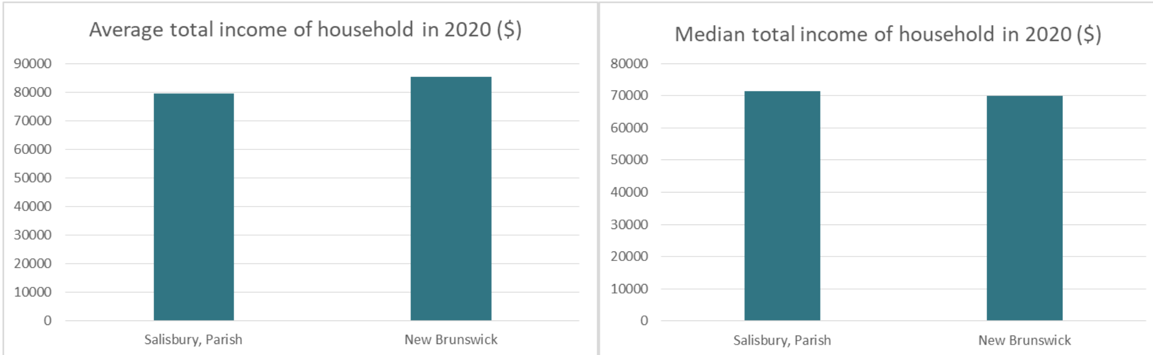

Figure 5.8.5: Income Statistics for Salisbury Parish and New Brunswick (Statistics Canada 2022)

Salisbury Parish has lower post-secondary education levels compared to New Brunswick as a whole, and a slightly higher percentage of residents in Salisbury Parish do not have educational certificates, diplomas, or degrees (2%) (Statistics Canada, 2022). There is an 8% difference between the share of Salisbury Parish residents who have completed high school or equivalent Salisbury Parish has a lower percentage of residents that have completed a post-secondary certificate, diploma or degree, at 41% compared to 51% (Statistics Canada 2022).

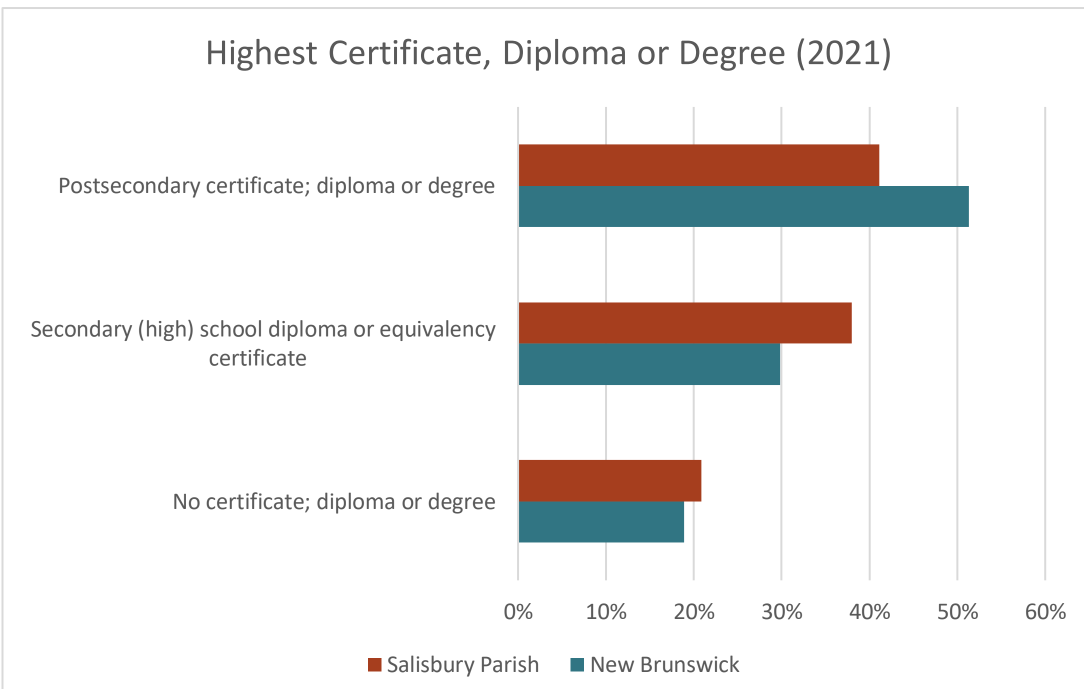

Figure 5.8.6: Education statistics for Salisbury Parish and New Brunswick (Statistics Canada 2021)

5.8.3 Environmental Effects Assessment

The environmental effects of the Project on the socioeconomic environment are assessed below.

5.8.3.1 Potential Effects

Without mitigation, the mechanisms by which the Project could interact with the socioeconomic environment are discussed below.

Effects on Residential Land Use

Construction of the Project and mining activities during operation have the potential to affect nearby residences as a result of light, noise, and dust generated by equipment operation and blasting. Ground vibration from blasting has the potential to damage private property.

The interaction of the Project with water resources is discussed in **Section 5.3**.

The Project may have a negative effect on the general enjoyment of private property due to elevated noise levels and increased truck traffic as well as perceived effects on aesthetic value of the area.

Effects on Commercial Land Use

Effects on the home-based business are expected to be similar to those on residences in that area.

Effects on Institutional Land Use

Accidents or malfunctions associated with construction and operation of the Project have the potential to result in an increase in calls for the Petitcodiac Volunteer Fire Department, as well as other emergency response organizations whose geographic area of response includes the preferred transportation route. Accidents and malfunctions are assessed in **Section 7.0**.

Effects on Industrial Land Use

Given the limited amount of current industrial land use in the LAA, no interactions are anticipated as a result of the Project on industrial land use.

Effects on Agricultural Land Use

The Project may indirectly affect local agriculture if surface or groundwater resources are adversely affected as a result of Project activities as those water sources may be used for irrigation or livestock consumption. Light, noise, and dust may also impact livestock grazing in the vicinity.

Effects on Forestry Land and Resource Use

The PDA was largely cleared in 2021, aside from immature shrubs that will be removed during a final clearing of the site. No additional land is anticipated to be required for the Project, and as such no interactions with forestry are anticipated.

Effects on Recreational Land and Resource Use

The Project will result in the unavailability of the PDA for use for recreational hunting, trapping or gathering, with such potential uses returning following closure.

Effects on Transportation Land Use

Traffic volumes on local roads are not expected to change significantly during the construction phase of the Project. Construction equipment will be mobilized to the site at the start of construction and will be removed once it is no longer required.

During operation, approximately 35-45 trucks per day will added to the existing traffic on the transportation route. An increase in traffic volume on the transportation route has the potential to impact the quality of the roads used for the Project leading to traffic delays, resulting in degradation of the infrastructure due to higher-than-normal loads. Increased risk of vehicle accidents is possible as the volume of traffic increases.

Effects on Employment and Economy

The Project will generate employment for up to 10 employees or contractors, and provide the local wallboard industry with a secure and financially viable source of natural gypsum needed to continue operations over the long term. Through generation of new employment and maintaining existing jobs at local wallboard facilities, with spin-off employment for third-party contractors, the effects of the Project on employment and economy of the region are expected to be positive overall.

5.8.3.2 Mitigation

Mitigation measures to reduce the environmental effects of the Project on the socioeconomic environment are identified below.

Residential Land Use

- Hammond River Holdings is committed to engaging with local residents prior to construction to identify and consider areas of concern related to the Project.
- Vehicles and equipment will be well muffled and maintained, and dust suppression will be applied to internal site roads during dry periods.
- The initial 30 m of access road between Route 890 and the security gate will be paved to minimize the transport of dust and mud from internal site roads to the provincial highway network.
- Where possible, efforts will be made to maintain as much mature vegetation that remains along the edges of the site as possible, so as to act as a visual and acoustic buffer.
- Blasting activities will be limited to approximately 25 blasts per year as an annual average (excluding nights, weekends, and statutory holidays), and a communication plan will be developed for residents who wish to be notified. Crushing operations will be conducted mostly within the open pit to minimize noise levels. Given that blasting, crushing, and material handling operations within the open pit will be conducted at depth (i.e., on benches within the pit and

below the surrounding ground surface, rather than at ground surface), topography and the presence of the pit walls will further reduce the off-site transport of noise emissions.

- Pre-blast surveys will be conducted at the nearest residences, and blasts will be periodically monitored using seismographs to confirm that concussion noise levels do not exceed a peak pressure level limit of 128 decibels (dBL) and that peak particle velocities (PPV) remain within 1.25 cm/s, as a best industry practice for quarry operations.
- Directional lighting will be used on site with a downward lateral focus to minimize light leaving the site.

Commercial and Institutional Land Use

- With several businesses within 1 km of the PDA, it is expected that these entities may interact with the project. The mitigation measures being taken to minimize impacts to residential land uses are the same impacts being taken to mitigate impact against commercial and institutional uses. Regarding potential effects on emergency response services related to the PDA or LAA, refer to **Section 7.0** for a discussion of mitigation related to accidents, malfunctions and unplanned events.

Agricultural Land Use

- Though there are agricultural operations in the LAA, there are no known groundwater or surface water supplies within 1 km of the PDA that could interact with the Project; thus, no residual effects are expected and no mitigation is proposed. An assessment of the environmental effects and the Project design and mitigation measures planned to address Project effects on water resources is provided in **Section 5.3**.

Forestry Land and Resource Use

- The PDA was largely cleared in 2021, and no additional land is expected for the Project, and as such no interactions with forestry are anticipated. Thus, no residual effects are expected and no mitigation is proposed.

Recreational Land and Resource Use

- The PDA is privately-owned and represents a relatively minor loss of potential land available for hunting, fishing, or trapping relative to the terrestrial wildlife habitat in the region.

Transportation Land Use

- The preferred transportation route was selected because it enables the transportation of larger payloads (i.e., 62,500 kg GVM) for most of its length compared to other possible trucking routes. Hammond River Holdings will work with the NBDTI to assess the condition of the weight bearing capacity of the route, including bridge crossings along the North River.

- Using larger payloads (if possible) enables fewer trips than would be possible on other trucking routes.
- Truck drivers will adhere to posted speed limits and warning signage and adjust driving to meet weather and road conditions.
- It is possible that oversized loads (very wide or heavy loads) will be required for equipment used during construction and operation. Transportation of these loads on public roads may require special permits from NBDTI and may require special markings, lead and follow vehicles, and temporary traffic interruptions.
- All necessary permits will be obtained and industry best practices will be followed for special moves or traffic interruptions on public roads.
- Transportation accidents and collisions are addressed in **Section 7.0**.

Employment and Economy

- No mitigation is proposed.

5.8.3.3 Characterization of Residual Effects

The residual environmental effects of the Project after the application of mitigation are assessed in this section.

Residential Land Use

The Project will result in the emission of dust, air contaminants, noise and vibration emissions that could cause a nuisance to off-site receptors, thereby affecting residential land use. Given the nature of the Project, the distance of the Project operations to the nearest residences, and the mitigation to be employed (including notably the use of dust suppression, the conduct of operations within the open pit below ground surface, conducting intrusive activities during daylight hours Monday to Friday, and other measures), the Project is not expected to result in the undue emission of air contaminants near residential properties. Blasting activities will be carefully controlled and limited to once or twice per week and residents will be notified prior to the blasts to minimize nuisance. Damage to property from Project operations (particularly blasting) are not expected as long as concussion noise levels do not exceed a peak pressure level limit of 128 decibels (dBL) and that peak particle velocities (PPV) remain within 1.25 cm/s, as a best industry practice for quarry operations. Refer to **Section 5.2** for a discussion on residual effects of noise and dust generation from the Project.

With respect to compatibility of land uses, the Project site has been used for forestry operations in the past, and the development of other resource extraction activities on the same site is believed to be compatible with past and present land uses in the area. A rezoning application for the Project is currently being evaluated by the Regional Service Commission.

Effects on property values are more difficult to determine, since the literature relating property values to proximity to industrial facilities is uncertain and widely reliant upon conjecture. Some studies suggest that proximity to an industrial facility may result in a decline in property values due to nuisance effects and potential damage, whereas others suggest that property values may increase if present near an industrial operation because workers tend to wish to live near where they work. As such, given the lack of clear outcomes in the literature body relating to the effect of industrial operations on property values, the anticipated effects of the Project on property values are ascribed as neutral in this case. Hammond River Holdings will monitor the resale value of homes in the area to determine if the Project might be affecting property values and to plan suitable adaptive measures as appropriate.

Commercial and Institutional Land Use

While the density of businesses and institutional uses in the LAA is low, there are several businesses present. The potential effects on commercial and institutional uses are expected to be similar to those on residential uses, though non-residential uses are not expected to be impacted by noise related to the Project at night, or outside of working hours. Therefore, the Project mitigation measures around dust control, acoustic buffers, blasting control will apply across different forms of land uses. Further, non-residential uses have operated alongside the PDA during previous resource-based uses, such as forestry and land clearing. The Project is anticipated to be compatible with past and present land uses in the area, and minimal residual effects on commercial and institutional land use are expected. Still, Hammond River Holdings will maintain ongoing dialogue with nearby business owners to identify and mitigate impacts as they arise. Refer to **Section 7.0** for a discussion of the potential residual environmental effects of Project-related accidents or collisions on emergency response services.

Agricultural Land Use

Potential effects of the Project on agricultural land use are primarily focussed on groundwater and surface water quality and quantity; refer to **Section 5.3** for a discussion on residual environmental effects of the Project on water resources.

Forestry Land and Resource Use

The PDA was largely cleared during 2021, and only the clearing of immature shrubs is likely required. As such no interactions with forestry are anticipated and therefore, no residual effects are expected.

Recreational Land and Resource Use

The PDA is privately-owned and represents a relatively minor loss of potential land available for hunting, fishing, or trapping relative to the terrestrial wildlife habitat in the region. Substantive interactions with recreational land use are not expected.

Transportation Land Use

The Project will result in a modest increase in traffic volumes on the transportation route during operation, with an estimated addition of 35-45 trucks per day. The transportation route enables the transportation of larger payloads for most of its length, meaning that damage to road infrastructure operating on these roads is not expected. Residents located along the transportation route may notice additional truck traffic at times, but since the highways are rated for such purposes and trucking has occurred and continues to occur on these roads, measurable impacts on transportation land use are not expected. Refer to **Section 7.0** for a discussion of the potential residual environmental effects of transportation related accidents or collisions.

Employment and Economy

The Project is expected to employ a modest workforce during operation of up to 10 personnel, supplemented by contractors for trucking and explosives. Construction will be carried out by a third party, with staffing levels yet to be finalized. A small, but positive interaction, is expected.

The Project will also indirectly support the employment of approximately 100 employees at the Atlantic Wallboard facility in Saint John, NB.

5.8.4 Summary

In summary, the Project may result in a perceived change in land use of the LAA, but since the Project site was cleared during the year 2021, the continued use of the PDA for resource extraction activities is expected to be compatible with the surrounding area. Occasional nuisance effects to nearby residents may be possible, but Hammond River Holdings will communicate periodically with residents to understand and consider concerns. Substantive effects to commercial, institutional, industrial, agricultural, forestry, recreation, or transportation land uses are not expected. Modest employment associated with the creation (or maintenance) of up to 10 jobs for Hammond River Holdings operations, as well as the related spin-off employment and economic activity from third party contractors and other suppliers in addition to maintaining employment at existing wallboard facilities, will result in positive effects to employment and economy.

In light of the above, and in consideration of planned mitigation and best practices aimed at reducing environmental effects, the residual environmental effects of the Project on the socioeconomic environment during each phase of the Project are rated not significant, with a high level of confidence.

5.9 Heritage Resources

The potential environmental effects of the Project on heritage resources are assessed in this section.

5.9.1 Scope of VC

Heritage resources has been selected as a valued component (VC) related to the Project due to their overall importance to the people of New Brunswick and in recognition of the provincial and federal regulatory agencies who are responsible for their management. Additionally, Indigenous people have an important interest in the preservation and management of heritage resources related to their history

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and culture. Heritage resources include archaeological resources (e.g., artifacts), palaeontological resources (e.g., fossils), and built heritage resources (e.g., historic buildings or sites).

Heritage resources, both human-made and naturally occurring, are those resources related to the past that remain to inform present and future societies of that past. Heritage resources are highly delicate features of the environment and their integrity is susceptible to ground-disturbing activities. Project activities that include surface or sub-surface ground disturbance has the potential for interaction with heritage resources, where they are present. Accordingly, earth moving activities represent the component of the Project with the greatest potential for interaction with heritage resources that might be contained in surface soils or rock.

Heritage resources in New Brunswick are protected under the New Brunswick *Heritage Conservation Act* as administered by the New Brunswick Department of Tourism, Heritage and Culture, and are considered to be important and highly valued by the people of New Brunswick (GNB 2018b). The *Heritage Conservation Act* clearly outlines the Province's ownership of all archaeological, palaeontological, and burial site heritage objects (GNB 2018b). Any such objects determined to be of Indigenous origin are specifically "held in trust" on behalf of Indigenous people and their communities (GNB 2018b). The Act also protects provincially designated heritage places. The following definitions for selected heritage resources are derived from the provincial *Heritage Conservation Act*:

- **Archaeological Object:** "*an object which shows evidence of manufacture, alteration or use by humans that may provide information about past human activities and which meets any criteria set by regulation, and includes a sample collected from that object*".
- **Archaeological Site:** "*a place where evidence of past human activities, such as archaeological objects and features, is discovered on, buried or partially buried beneath the land, or submerged or partially submerged beneath the surface of a watercourse or permanent body of water*".
- **Burial Ground:** "*a place that has been used for the placement of human remains or burial objects, but does not include a cemetery regulated under the Cemetery Companies Act*".
- **Burial Object:** "*an object that is directly associated with the interment of a human, but does not include human remains*".
- **Palaeontological Object:** "*a work of nature consisting of or containing any remains, trace or imprint of a multicellular plant or animal or a stromatolite preserved in the Earth's crust since some past geologic time; does not include human remains*".
- **Palaeontological Site:** "*a place where evidence of palaeontological objects is discovered in rock or unconsolidated sediment, exposed at the surface, buried or partially buried beneath the land, or submerged or partially submerged beneath the surface of a watercourse or permanent body of water*".

The Province of New Brunswick provides guidance for conducting heritage assessments under its *Guidelines and Procedures for Conducting Professional Archaeological Assessments in New Brunswick* (Archaeological Services 2012).

5.9.1.1 Temporal Boundaries

The temporal boundaries for the Project include the following:

- **Construction**: extending for a period of approximately four months, anticipated to begin in the fourth quarter (Fall) of 2023 (subject to the receipt of all approvals and permits required for the Project);
- **Operation**: beginning in approximately the first quarter of 2024, and lasting for approximately 10 years or until the mineral resource has been depleted; and,
- **Reclamation and closure**: to be initiated following the completion of operations at the site, with decommissioning and reclamation of the surface facilities at the site for an anticipated duration of six months following operation.

5.9.1.2 Spatial Boundaries

The Project development area (PDA) is defined as the area of physical disturbance associated with construction and operation of the Project. Specifically, the PDA consists of an area of approximately 85 ha (i.e., conservatively assumed to be the entirety of PIDs 00814160, 70076948, and 70654058) that includes the open pit and all related surface facilities located on the property. The PDA is the area represented by the physical Project footprint.

The local assessment area (LAA) is the maximum anticipated area within which Project-related environmental effects are expected. For heritage resources, the LAA is not expected to extend beyond the PDA, as an environmental effect would be related to ground disturbance/earthworks (to occur only within the PDA).

5.9.1.3 Significance Threshold

A significant adverse residual environmental effect on heritage resources is one where Project-related activities result in the permanent disturbance or unauthorized accidental destruction of an archaeological, palaeontological, or built heritage resource, site, or object (as they are defined above in **Section 5.8.1**) that is considered by the provincial heritage regulators to be of major importance and that cannot be mitigated.

5.9.2 Existing Conditions

To assess the potential for significant adverse residual environmental effects on heritage resources, a preliminary archaeological impact assessment (AIA) was completed. The details of the preliminary AIA for the Project as well as a description of the existing conditions in relation to the potential for heritage resources within the PDA is described in the following sections.

The potential for heritage resources to be located within the PDA is defined by the application of a three-pronged approach to AIA preliminary investigation that includes: desktop assessment, public and Indigenous engagement, and then preliminary field assessment (walkover). Dillon retained Cultural Resources Management Group Limited (CRM Group) to conduct the AIA in support of the proposed EIA Registration. The methods used and proposed by the CRM Group's professional archaeologist for the components of the AIA are described in the following sections.

Several environmental factors such as glacial history, topography, surficial geology, hydrology, and vegetation have influenced settlement patterns and contributed to the evaluation of the archaeological potential of the area.

The study area is located within the Eastern Lowlands Ecoregion, along the western boundary of the Petitcodiac Ecodistrict that encompasses the Petitcodiac River basin (Zelazny 2007, p. 304). The ecodistrict is dominated by the Petitcodiac River, which begins with the convergence of North River and Anagance River near the village of Petitcodiac. The Petitcodiac River flows northeast, following the regional bedrock structure before abruptly turning southward into Shepody Bay. The eastern half of the ecodistrict contains the Memramcook and Tantramar rivers. These three river systems are separated by two peninsulas that also separate Shepody Bay from Chignecto Bay. Elevation within the ecodistrict ranges from 1 to 165 m amsl. Elevation within the study area ranges from 40 to 80 m amsl.

5.9.2.1 Archaeological Impact Assessment - Preliminary Investigation Methods

The first stage of conducting an AIA in New Brunswick is a preliminary investigation, which includes a desktop assessment (i.e., documentary research), engagement with local individuals and/or groups (including First Nations), and preliminary field investigation (i.e., a walkover) (CRM Group 2022). The current *Guidelines and Procedures for Conducting Professional Archaeological Assessments in New Brunswick* (Archaeological Services 2012) stipulate that an Archaeological Field Research Permit (AFRP) is required to undertake a Preliminary Field Investigation (the third component of a Preliminary AIA Investigation) (CRM Group 2022). The specific proposed methods that CRM Group undertook to complete an AIA for the PDA are outlined below.

Background Study

The background study component of the AIA was designed to explore the environmental setting and land use history of the study area and to provide information necessary for evaluation of the area's potential to contain archaeological resources.

Local Engagement

Engagement with knowledgeable residents and/or groups was undertaken to elicit information on the location, distribution, and significance of reported and /or unreported heritage resources. Individuals and groups contacted included the Curator of the Keillor House Museum and Chair of the Westmorland Historical Society, and an Archivist from the Provincial Archives of New Brunswick.

Documentary Research

The documentary research component of the background study involved investigation of resources at various institutions, including the Archaeology and Heritage Branch (AHB) Office, the Provincial Archives of New Brunswick, the Department of Natural Resources Library, and the Westmorland Historical Society.

The research included a review of relevant historic documentation incorporating land grant records, legal survey and historic maps, local and regional histories, and previous archaeological reports. Topographic maps and aerial photographs, both current and historic, were also used to evaluate the study area. Recent glaciological and geological research along with Satellite and LiDAR Digital Elevation Models (DEM) data were reviewed to aid in establishing historic shorelines and evaluate topography. These data facilitated the identification of environmental and topographic features that would have influenced human settlement and resource exploitation patterns. The historical and cultural information was integrated with the environmental and topographic data to identify potential areas of archaeological sensitivity. In-house GIS potential modelling was utilized to review the study area's position relative to existing registered archaeological sites, locations of cultural or heritage significance, and navigable water bodies.

In preparation for field work, the information obtained from this suite of research materials was reviewed to facilitate the interpretation of archaeological features encountered.

Previous Archaeological Assessments

During the background study, CRM Group reviewed reports for AIAs previously undertaken near the LAA. The review heightened knowledge of relevant archaeological data and served to ready field personnel for the task of identifying and interpreting archaeological resources encountered during fieldwork.

Preliminary Field Examination

Once the results of engagement and background research were reviewed and applied, CRM Group staff conducted archaeological reconnaissance across the LAA. Undertaken on-foot, the reconnaissance involved visual inspection of the ground surface while walking transects spaced suitably for comprehensive examination. Particular attention was paid to areas where past cultural features and/or zones of elevated archaeological potential were indicated by engagement or documentary research. This field observation was designed to further delineate areas of archaeological potential and, where possible, areas where archaeological potential was eliminated by modern ground disturbance (e.g., modern development). During the survey, the archaeologists were watchful for topographic anomalies or visible features that might indicate the presence of buried archaeological resources, such as historic foundation remains, cellar depressions, road cuts, and artifacts in soil exposures.

During the site reconnaissance, field geomatic data were recorded with a handheld Garmin GPS map 62s with +/- five-metre accuracy. Field observations were recorded through a combination of photographs, field sketches, and field notes.

5.9.2.2 Potential for Heritage Resources within the PDA – Preliminary Characterization

In recognition of the historical use of watercourses as travel route during both the Pre-Contact period (i.e., before the arrival of Europeans) and the Historic period (i.e., the 1700s and 1800s, during which colonization took place), the Archaeological Services (2012) guidelines stipulate that the first 50 m from a watercourse is considered to have a high potential for archaeological resources, while the following 30 m are ascribed as moderate archaeological potential. Beyond 80 m of a watercourse, areas are generally identified as having low archaeological potential. The confluence of watercourses tends to be ascribed a high archaeological potential, recognizing that confluences were often historically used as camping or gathering sites. Other landscape features (such as topographical features or elevated vistas) are also often characterized as having high archaeological potential.

The background study detailed the physiographic environment of the Petitcodiac River watershed and indicated longstanding use of the river system as a place of resource extraction and as a transportation corridor used by the Mi'kmaq since time immemorial. The history of Wisconsin Glaciation in the region suggests that a Palaeoshoreline may have existed within the east-central portion of the study area. However, marine deposits have not been identified in past geological work encompassing the PDA or surrounding area (NBDNRE 1986; Pronk et al. 2005) or during geological field work completed during this assessment. The absence of marine deposits within the PDA indicates a palaeoshoreline likely could not have existed. Notwithstanding, out of an abundance of caution zones of moderate and high potential for Pre-contact period archaeological resources were ascribed within the LAA.

Moderate archaeological potential was also ascribed to each of the two areas of historic features, with a buffer zone extending outward to a radius of 25 metres. The buffer zone surrounding the historic farmstead does not include the former driveway of the property, which is ascribed low archaeological potential. Other areas of the LAA are ascribed low archaeological resource potential, showing no sign of historic period development, and being relatively sloped and distant from sources of water.

A palaeontological report is currently in preparation and will be provided in a supplemental report, when available.

5.9.3 Environmental Effects Assessment

The potential environmental effects of the Project on heritage resources are assessed in this section.

5.9.3.1 Potential Effects

As a result of the preliminary desktop assessment (including model/mapping database check for high potential resource areas), there is moderate to high potential for heritage resources to be located within some areas of the PDA.

Should the discovery of heritage resources occur during the construction or operation phases of the Project, it would be considered and addressed as an accidental event, as discussed in **Section 7.0**.

5.9.3.2 Mitigation

The 2022 Preliminary Investigation stage of the AIA made four recommendations:

- It is recommended that ground disturbance within zones of high archaeological potential be preceded by the Field Evaluation stage of an Archaeological Impact Assessment, including systematic subsurface archaeological testing at 5-metre intervals.
- It is recommended that ground disturbance within zones of moderate archaeological potential be preceded by the Field Evaluation stage of an Archaeological Impact Assessment, including systematic subsurface archaeological testing at 10-metre intervals.
- It is recommended that the remainder of the LAA be cleared of the requirement for further archaeological investigation.
- It is recommended that Archaeological Impact Assessment be applied in advance of ground impacts in extension of the LAA described and depicted in this report.

If heritage resources are accidentally identified over the course of the Project, the following mitigative measures for archaeological resources will be employed:

- Work in the area must cease immediately and the Archaeology and Heritage Branch of the New Brunswick Department of Tourism, Heritage and Culture will be contacted at (506) 453-3014 for further mitigation;
- Until a qualified archaeologist arrives at the site, no one shall disturb, move or re-bury uncovered objects; and,
- Activities at the site may resume only when authorized by the Archaeology and Heritage Branch and once mitigative measures have been completed.

Other contingency and emergency response procedures to be implemented in response to the accidental discovery of heritage resources will be documented and implemented as part of the EPP for the Project.

5.9.3.3 Characterization of Residual Effects

Any ground breaking or earth moving activity has the potential to uncover previously undiscovered heritage resources. Archaeological resources (i.e., artifacts) tend to be found in surficial soils and when discovered, whereas palaeontological resources (i.e., fossils) tend to be found in bedrock. The discovery of these resources can provide valuable information about human activity or use in the distant past (in the case of artifacts), or the presence of wildlife and vegetation in earlier eras (in the case of fossils). With respect to the Project, it is possible that previously undiscovered heritage resources in the form of artifacts could be found in the surficial soils (including topsoil and overburden) during construction of the Project. Moreover, it is possible that fossils could be found in the underlying gypsum rock during operation of the Project.

5.9.4 Summary

Based on the preliminary desktop assessment conducted by CRM Group and Dillon, some parts of the PDA are located within an area that is believed to be of moderate to high archaeological potential. The potential for heritage resources to be present within the PDA is also considered moderate; and interactions between the Project and heritage resources may occur. However, in consideration of the results of the AIA, the residual environmental effects of the Project on heritage resources during each phase of the Project are rated not significant, with a moderate level of potential until they can be confirmed as low potential through subsurface archaeological testing as recommended by CRM Group.

The CRM Group provided recommendations to mitigate the potential of interactions between the Project and heritage resources. This includes systemic subsurface archaeological testing at 5-metre intervals. As certain areas of the site were assessed as having moderate archaeological potential, a Field Evaluation is recommended with subsurface archaeological testing at 10-metre intervals. The remainder of the study area can be cleared for further investigation, though an Archaeological Impact Assessment should be applied ahead of ground impacts within the LAA.

If heritage resources are accidentally identified over the course of the project, work in the PDA will cease immediately, and the Project Team will contact the Archaeology and Heritage Branch of the New Brunswick Department of Tourism, Heritage and Culture for further mitigation.

5.10 Traditional Land and Resource Use

The potential environmental effects of the Project on traditional land and resource use are assessed in this section.

5.10.1 Scope of VC

Traditional land and resource use refers to the practice of traditional activities by Indigenous persons that were carried out dating back to the Pre-Contact[1] period (GNB 2011). These activities may have included hunting, fishing, trapping, gathering of food and medicines in pursuit of a moderate livelihood, as well as the building and settling of encampments, seasonal travel, practicing ceremonial traditions, and burial activities. Evidence of these traditional land and resource uses can generally be found in

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[1] The Pre-Contact period is defined as the time and events of Indigenous society that occurred prior to contact with non-Indigenous cultures, which began here around *ca.* 1500 current era (CE). The Contact period is the era between *ca*. 1500 and 1604 CE, when Indigenous and non-Indigenous cultures were first contacting one another intermittently across the region, which is largely unrecorded except in oral history and the archaeological record.

archaeological evidence (i.e., archaeological sites, burial sites, and associated objects) and through Indigenous traditional knowledge and oral histories. Traditional land and resource use has been selected as a valued component (VC) in order to:

- Acknowledge the lands and resources historically used for traditional purposes by Indigenous persons;
- Assess the potential environmental effects of the Project as required under the New Brunswick *Environmental Impact Assessment Regulation*; and,
- Assist the Province in fulfilling its duty to consult with Indigenous peoples regarding the Project.

This section of the EIA Registration is intended to provide the Crown with information about the potential environmental effects of the Project on traditional land and resource use, as well as measures taken or recommended that would mitigate such environmental effects.

5.10.1.1 Temporal Boundaries

The temporal boundaries for the Project include the following:

Construction: extending for a period of approximately four months, anticipated to begin in the fourth quarter (Fall) of 2023 (subject to the receipt of all approvals and permits required for the Project);

- **Operation**: beginning in approximately the first quarter of 2024, and lasting for approximately 10 years or until the mineral resource has been depleted; and,
- **Reclamation and closure**: to be initiated following the completion of operations at the site, with decommissioning and reclamation of the surface facilities at the site for an anticipated duration of six months following operation.

5.10.1.2 Spatial Boundaries

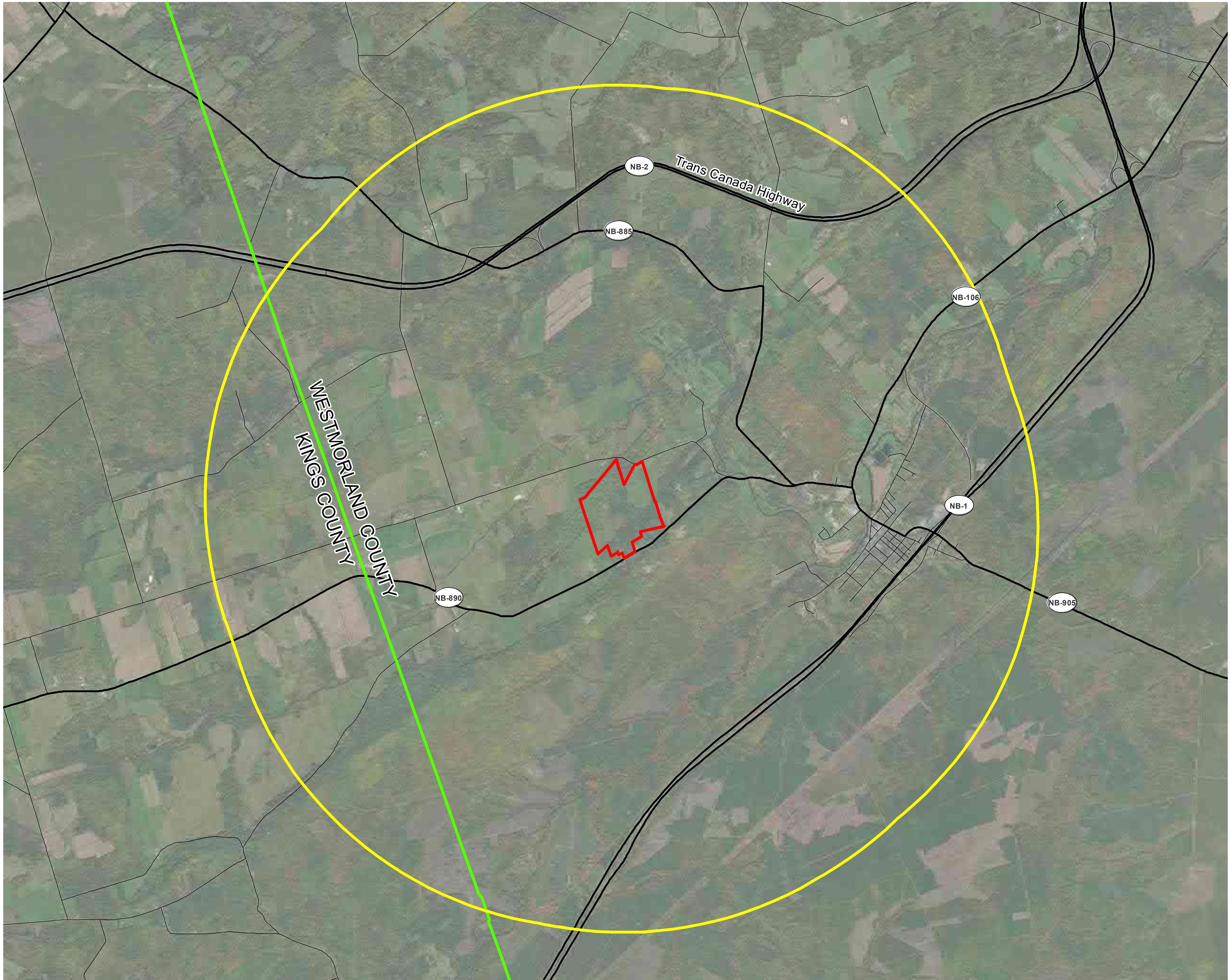
The spatial boundaries of the environmental effects assessment completed are shown in **Figure 5.10.1**, and are described as follows.

The **Project development area (PDA)** is defined as the area of physical disturbance associated with construction and operation of the Project. Specifically, the PDA consists of an area of approximately 85 ha (i.e., conservatively assumed to be the entirety of PIDs 00814160, 70076948, and 70654058) that includes the open pit and all related surface facilities located on the property. The PDA is the area represented by the physical Project footprint as presented on **Figure 2.3.1**.

The **local assessment area (LAA)** is the maximum anticipated area within which Project-related environmental effects are expected, and is representative of Dillon's professional interpretation of the zone of influence of the Project on traditional land and resource use. Though development of the Project will be limited to the PDA, some areas contiguous to the PDA may be affected upon initiating construction and operation of the Project, even though they will not necessarily be physically disturbed (e.g., potential indirect effects on wetlands located on adjacent properties). In recognition of this, the LAA (**Figure 5.10.1**) for traditional land and resource use consists of an area of 9,845 ha, forming a 5 km radius surrounding the PDA and contiguous areas which traditional land or resource use may have occurred or may be occurring. For this reason, the LAA was conservatively defined as representing a 5 km radius centred on the PDA to assess and consider potential biophysical and atmospheric effects from the PDA and areas where Project-related environmental effects might be expected to occur.

5.10.1.3 Significance Threshold

A significant adverse residual environmental effect on traditional land and resource use is defined as a permanent loss of the availability of, or access to, land and resources that are currently used by Indigenous persons for traditional purposes within the LAA or PDA that cannot be mitigated.



HAMMOND RIVER HOLDINGS LIMITED
PROPOSED GLENVALE GYPSUM QUARRY

SPATIAL BOUNDARIES FOR TRADITIONAL LAND AND RESOURCE USE
FIGURE 5.10.1

Highway
Road
Counties
Project Development Area
5km Raduis

0 0.25 0.5 1 Kilometers
SCALE 1:50,000

MAP DRAWING INFORMATION:
DATA PROVIDED BY DILLON CONSULTING LIMITED, CANVEC
SERVICE LAYER CREDITS: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), SWISS TOPO, OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

MAP CREATED BY: RP
MAP CHECKED BY: JO
MAP PROJECTION: NAD_1983_CSRS_NEW_BRUNSWICK_STEREOGRAPHIC

DILLON CONSULTING

PROJECT: 22-4280
STATUS: FINAL
DATE: 2022-09-22

FILE LOCATION: K:\2022\224280\Product\Client\Glenvale\HarrisonFigures\Glenvale_Figure1_LAA.mxd

5.10.2 Existing Conditions

Based on a review of available literature, the following is a brief and high-level summary of traditional land and resource use in the LAA. It is important to note that no interviews related to the history of the LAA or the properties in or around the PDA have been conducted with historical society groups or First Nations representatives for the purposes of developing this EIA Registration document, and the following information is based on literature review.

5.10.2.1 Project Context

The PDA is located within the Regional Service Commission (RSC) 7 and in the LSD of Salisbury.

The Project is at an early developmental stage, and engagement with Indigenous communities about the Project has been initiated. The engagement process is intended to support an improved understanding of the traditional land use, and potential impacts to rights of the PDA. It can be assumed that lands and resources near the Project could have been, and could be used for traditional purposes by the Mi'kmaq Nation (and possibly other Indigenous communities). The Project site is located within what has been traditionally recognized as the Wolastoqiyik and Mi'kmaq Nation's traditional territories, and the PDA is located within the Title Claim submitted to the Court of King's Bench of New Brunswick by the Elsipogtog First Nation. More specifically, the surrounding wetlands, watercourses, and agricultural and forested lands could have been used by Indigenous peoples as part of their traditional territory. Construction and operation of the Project may affect or alter the ability of Indigenous peoples to use lands and resources surrounding the PDA and adjacent areas within the LAA to carry out their traditional activities, if they are being carried out there.

The information presented in this section is intended to provide a high-level overview of Indigenous traditional land and resource use in the general area of the Project. The information and assessments provided below are derived from publicly-available literature and general knowledge and information relating to Indigenous traditional land and resource use in the Glenvale area. This information is not intended to supersede or prejudice the specific traditional land or resource use information or knowledge that may be shared as part of engagement and consultation with Indigenous communities. Rather, it is an attempt to provide information from general knowledge and secondary sources of information that is intended to complement the traditional knowledge that might become available from Indigenous people in this regard.

Documented details on how and where traditional activities have been or are taking place may exist, but they are normally held confidentially by Indigenous peoples and their representative organizations. This knowledge is both valuable and private to the Indigenous community (land users), and as such there is an expectation that this knowledge should not be freely available to proponents for the purposes of development of traditional territories. As such, information presented within this section has been collected from reliable secondary sources and will be confirmed with Indigenous knowledge holders over the coming months, should the Nations decide to do so. Indigenous knowledge of traditional land and resource use(s) within the PDA and LAA will be obtained from planned discussions with Indigenous communities, to assist in identifying potential environmental effects and possible mitigation measures. Furthermore, data collected for other field disciplines (e.g., wildlife and wildlife habitats, vegetation and wetlands, fish and fish habitat, and heritage resources) will also be used to inform the availability of land and resources that could be used for traditional purposes within the LAA and PDA.

5.10.2.2 Indigenous Community Context

Indigenous people in New Brunswick hold affirmed Aboriginal and treaty rights under Section 35(1) of the *Constitution Act, 1982*. The Supreme Court of Canada has held in several important decisions that the Crown (federal and provincial) has a duty to consult with potentially affected Indigenous people in respect of decisions made by the Crown that might affect these constitutionally-protected Aboriginal and treaty rights, including those that might relate to their current use of the land and resources for traditional purposes. The Province of New Brunswick has a duty to consult policy which is administered by the New Brunswick Department of Aboriginal Affairs (GNB 2011).

Historically, the lands of Central New Brunswick have been used by Indigenous persons for traditional uses such as hunting, fishing, gathering, trapping, subsistence, and related purposes (Goddard 1996). The traditional territories of the Indigenous peoples in New Brunswick, the Mi'kmaq and Wolastoqey peoples have asserted that all of New Brunswick makes up part of their traditional territories.

There are fifteen Indigenous communities recognized within the province of New Brunswick, plus the Peskotomuhkati Nation in southwestern New BrunswickThe 15 recognized communities consist of nine (9) Mi'kmaq Nation communities and six Wolastoqey Nation communities. Mi'kmaq communities are predominantly located along the northern and eastern coastal regions of the province, while the Wolastoqey communities and their traditional territory are generally located along the Wolastoq (St. John River) valley. Indigenous peoples migrated through and used the entirety of the lands in New Brunswick for millennia and as such, the proponent has a policy to engage with all sixteen Indigenous communities in New Brunswick so that each Indigenous community and organization can decide to engage with the proponent on potential projects in New Brunswick.

5.10.2.3 Population Demographics

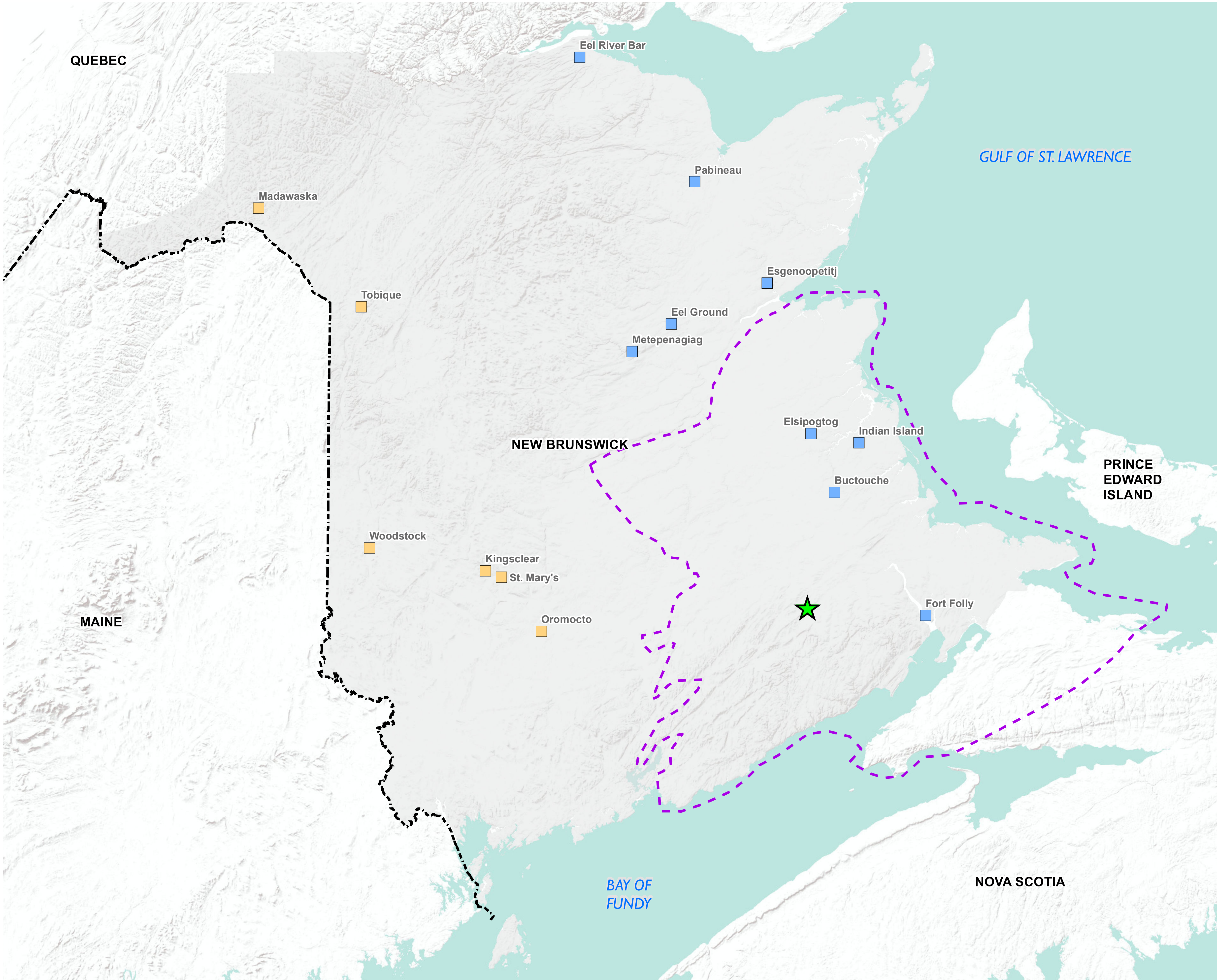
There are currently no Indigenous communities located within or immediately near the PDA or LAA. The closest Indigenous community to the PDA is the Saogao 35 Reserve administered as part of the Elsipogtog First Nation, located 27 kilometers from the Project site, and is comprised of three parcels. At this time, these parcels appear to not be inhabited based on satellite imagery. The status of whether the reserve land is inhabited or in development is not static and likely to change. The Metepenagiag Urban Reserve No. 3 is located roughly 47 kilometres northeast from the PDA, near the City of Moncton. Fort Folly First Nation is located an 89-kilometre drive east, primarily along the TransCanada Highway. Oromocto First Nation is located approximately 116 kilometres west of the PDA, with St. Mary’s First Nation being located slightly further to the east, at 134 kilometres from the PDA.

In 2016, the Elsipogtog First Nation made an Aboriginal Title Claim on behalf of the entire Mi’kmaq Nation over the portion of Mi'kma'ki known as Sikniktuk or District 6, including the land, airspace, land covered by water, offshore and inshore water bodies, foreshore, rivers, lakes and streams situated within its bounds (the "Claim Area") (Elsipogtog First Nation 2016). A map of the Claim Area (**Figure 5.10.2**) displays that the PDA is currently situated within the Elsipogtog First Nation Land Claim. The assertion of title produced by the Elsipogtog First Nation is for the jurisdiction over how the land and water will be used on Crown land in Mi’kmaq territory. It is believed that the assertion of title is not likely to affect privately-owned land. However, associated effects to lands contiguous of the PDA (such as public lands located within the LAA) must be further considered.

5.10.2.4 Current Use of Land and Resources for Traditional Purposes in the PDA and LAA

Traditional activities (e.g., hunting, trapping, fishing, and gathering) may occur within the LAA; however, the specific traditional activities that may be taking place in the LAA (including their locations) are not readily available. Normally, information relating to traditional activities taking place or having taken place in a particular location would be obtained through engagement of Aboriginal persons as well as through the conduct of an Indigenous Knowledge and Land Use and Occupation Study (IKLOS) (sometimes called a traditional knowledge [TK] study). Indigenous communities were informed of planned exploration drilling activity for the Project as part of the issuance of an exploration permit by NBDNRED. Hammond River Holdings has begun engaging Indigenous communities more formally in respect of the Project through an introduction letter sent to the Chiefs of the sixteen Indigenous communities in New Brunswick on June 3, 2022, to provide an initial introduction regarding the Project and to seek further engagement (if that is the desire of the Chiefs and/or their representative organizations). An IKLOS has been requested by MTI, a request Hammond River Holdings will consider.

As such, specific information about which traditional activities may have historically been conducted or are currently occurring specifically in the PDA and LAA is not available. However, it can be expected that the watercourses near the Project (particularly the Petitcodiac River and some larger tributaries) would have been used at some time for fishing and navigation by Indigenous persons, and that the lands would have been used by Indigenous persons for hunting, trapping, and gathering for food, medicines, and plants of traditional importance. In the absence of specific information in this regard, though located on



HAMMOND RIVER HOLDINGS LIMITED
PROPOSED GLENVALE GYPSUM QUARRY

FIRST NATIONS COMMUNITIES IN NEW BRUNSWICK
FIGURE 5.10.2

Site Location
Maliseet (Wolastoqey)
Mi'kmaq
Canada-USA Border
Elsipogtog Title Claim

20 10 0 20 Kilometres
SCALE 1:1,550,000
N W E S

MAP DRAWING INFORMATION:
SERVICE LAYER CREDITS: ESRI, USGS, NOAA
DATA PROVIDED BY: DILLON CONSULTING LIMITED, NB DEPARTMENT OF NATURAL RESOURCES, NB DEPARTMENT OF ABORIGINAL AFFAIRS, INTERNATIONAL BOUNDARY COMMISSION

MAP CREATED BY: RP
MAP CHECKED BY: HE
MAP PROJECTION: NAD_1983_CSRS_NEW_BRUNSWICK_STEREOGRAPHIC

DILLON CONSULTING

PROJECT: 22-4280
STATUS: DRAFT
DATE: 2022-12-16

privately-owned land, it is conservatively assumed that the PDA has been and is being used for practicing traditional activities by Indigenous persons, at the convenience of the landowner. Further specific information in this regard is expected to be obtained through engagement of Indigenous communities, as engagement progresses.

5.10.2.5 Traditional Land Use in and near the PDA

As noted in CRM Group (2022), the Mi'kmaw term weji-sqalia'tiek, meaning "we sprouted from [this landscape]", vividly conveys a personal and cultural connection with the landscape of Mi'kma'ki. The strength of this bond is reflected in Mi'kmaw legends and place names, both of which often highlight cultural elements such as local historic events, key resources, and essential meaning, demonstrating an intimate understanding of the area gained through countless generations of exploration, use, and occupation (Sable & Francis 2012; Jacobson 2022). Several traditional Mi'kmaw names for places near the LAA are listed in the table below (**Table 5.10.2**).

Table 5.10.1: Traditional L'nu place names near the study area (Mi'gmawe'l Tplu'taqnn Inc., 2022)

Traditional Name	English Translation	Contemporary Name	Distance from LAA
Oonegunce	A portage	Anagance River	1.8 km SE
Pet-koat-kwee-ak	The river bends around a bow	Petitcodiac River	2.3 km E
Penobsq-sips	A stone brook	Penobsquis	20.5 km SW

Contemporary place names can also illustrate the traditional areas of occupation and the nature of subsistence surrounding the study area. Names such as Indian Mountain, approximately 33 kilometres northeast of the LAA, are likely indicators of past Mi'kmaw habitation.

The LAA lies near a primary watercourse emptying into the Bay of Fundy and an important portage route connecting river systems across southern New Brunswick. The Petitcodiac and Anagance rivers were important transportation corridors and a resource bases for the Mi'kmaq and their ancestors for millennia prior to the arrival of European settlers. During the Pre-contact period, the Petitcodiac River system would have served as a natural travel-way linking Mi'kmaw communities at villages at modern day Salisbury, Moncton, and Dorchester with their Wolastoqey neighbours in the west and southern portion of the region, all the way to the Fundy Shore. While coastal habitation sites could make use of intertidal zones to exploit rich food resources, interior sites became specialized seasonal harvest sites (Lewis 2007). Upriver stone weir systems were designed to capitalize on limited period use such as for salmon runs. The planned resource acquisition strategies tell of a deliberate land use within Mi'kma'ki with areas of greater return yielding more attention from the Mi'kmaq (CRM Group 2022).

5.10.3 Environmental Effects Assessment

The environmental effects of the Project on traditional land and resource use are assessed in this section.

5.10.3.1 Potential Effects

Any Project activity that results in change in the amount of land available to practice current activities, or that restricts access to an area that limits the use of the resources found in that area, can affect traditional land and resource use. Activities during the construction, operation, and reclamation and closure phases of the Project may affect traditional land and resource use, as follows.

- Upon initiating construction, access to the PDA will be restricted for safety and security purposes to prevent injury to individuals while numerous construction activities are taking place on the Project site. From this time onward, access to the PDA for the purpose of carrying out traditional activities will no longer be available until following closure, although the remainder of the LAA will remain available for such purposes (as currently). These access restrictions will continue throughout the construction and operation phases, but will be restored following reclamation and closure so that traditional activities can return (if desired/available).
- During construction, most of the PDA will be cleared of remaining vegetation (except for areas remaining as buffers), and as such, natural resources that may be present on-site (e.g., plants, wildlife, medicines) will no longer be available for harvesting or use. Outside the PDA, it is not expected that Project-related effects would interfere with the practice of traditional activities in the remainder of the LAA or beyond. This effect will continue throughout the construction and operation phases, but will be restored upon site reclamation and closure.
- At closure, the Project site will be reclaimed and restored to as near natural conditions as possible. Although the open pit will remain as a water feature, the remainder of the Project site will be reshaped and allowed to naturally re-vegetate over time. Vegetation would be expected to begin growing naturally over time (e.g., within one or two growing seasons), and native vegetation, hydroseed, and the planting of trees may be used to accelerate this as well as to assist in promoting regrowth and to stabilize soils to prevent erosion. As vegetation matures over the ensuing years and decades, the PDA may once again eventually harbour traditional resources of importance to Indigenous peoples, thereby allowing a potential return of traditional land and resource use activities such as hunting, trapping, and gathering in the PDA, if so desired.

5.10.3.2 Mitigation

Traditional land and resources are connected to other VCs. Discussion of the potential environmental effects on natural resources and associated mitigation measures are outlined in **Section 5.3** (water resources), **Section 5.4** (fish and fish habitat), **Section 5.5** (vegetation and wetlands), **Section 5.6** (wildlife and wildlife habitat), **Section 5.7** (agricultural land and livestock), and **Section 5.8** (heritage resources). Those mitigation measures are also applicable to this particular VC. In addition, the following mitigation measures through careful planning will be employed to avoid or reduce the environmental effects of the Project on traditional land and resource use within the LAA:

- Minimize the size of the PDA to that which is necessary to accomplish the Project objectives while minimizing environmental disturbance to the extent possible.
- Maintain natural vegetation along wetlands and watercourses, as well as along the property boundaries, to minimize effects on natural resources and to provide a buffer for reducing effects of the Project that could cause sensory disturbance to wildlife (i.e., noise, dust).
- Conduct ongoing engagement of Indigenous communities throughout the Project to exchange information, address concerns, and assist in the development of management and reclamation plans for the Project.
- If requested, Indigenous communities or individuals will be provided with the opportunity to harvest and gather species of importance to traditional activities on the PDA prior to construction, if the Project schedule allows. These opportunities to conduct harvesting and gathering activities should be timed where possible to coincide with the seasonality of the species of interest, if possible, given the construction schedule.
- Reclamation of the PDA will consider traditional resources including the use of native species so that the land is accessible for traditional purposes at some time in the future following closure of the Project.
- Any fish and fish habitat will be monitored to confirm water flows are appropriate to mitigate bank erosion.
- Any affected fish habitat and wetland habitat that is lost to the Project will be authorized under federal and provincial legislation and offset in accordance with DFO policies.
- Wildlife and wildlife habitats within the PDA will be re-vegetated upon closure, which will partially restore habitat conditions in the PDA, over time.

5.10.3.3 Characterization of Residual Effects

Though located on privately-owned land, the presence of Project-related facilities and infrastructure will interact with traditional land and resource use, causing potential residual effects primarily within the PDA. Although minor effects could occur outside the PDA but within the LAA (e.g., wildlife avoidance due to human activity), effects will be greatest in the PDA.

The potential environmental effects to traditional land and resource use would begin as soon as construction activities are initiated and would continue throughout the Project life, until the site is restored to as near natural conditions as possible during reclamation and closure. The greatest potential for environmental effects begins when initiating construction activities, after which time access to the PDA will be restricted for safety purposes. The resources present in the PDA (such as wildlife and fish habitats) will be lost during construction as clearing of the site and development of the open pit and ancillary facilities is conducted, resulting in such resources no longer being available for traditional purposes during construction and operation of the Project. The potential environmental effects on traditional land and resource use are thus conservatively assessed as occurring immediately when construction (site preparation) begins, and continuing until ultimate closure of the site.

Ground disturbance during construction and operation activities will result in a temporary localized loss of vegetation and potential displacement of species used for traditional purposes due to altered habitats or sensory disturbance. Where practicable, Indigenous communities and individuals will be provided with the opportunity to harvest and gather species before site preparation and construction commences, if the timing of such harvesting is such that the activity does not interfere with site activities.

At closure, the quarry will be abandoned and the site will be restored to as near natural conditions as possible by allowing vegetation to re-grow naturally (supplemented by planting native vegetation, hydroseeding, and planting of trees to reduce potential erosion), with no anticipated substantive interactions between the Project and traditional land and resource use expected following reclamation. A short-term and temporary restriction in access to land and resources within the PDA would result during reclamation activities. Once decommissioning and reclamation is complete, this site restriction will be eliminated, resulting in improved access to the PDA and improvement of environmental features and other traditional purposes within the LAA.

Ongoing engagement with the Indigenous communities will continue to take place, and they will be provided the opportunity to support the development of management and reclamation plans and/or to support reclamation activities at the site. If requested by Indigenous communities, a TLRU study may be conducted to identify specific current traditional uses in the PDA that might require accommodation, where reasonable. Nonetheless, a reduction in the use of land, or the resources on the land within the LAA, is unavoidable throughout the life of the Project, and to a lesser extent after closure activities are complete.

5.10.4 Summary

The development of the Project will not result in the permanent loss of access or use of land or resources, as the site will be returned to near-natural conditions following reclamation and closure.

Engagement with Indigenous communities about the Project has been recently initiated, and is intended to support an improved understanding of the traditional land use of the PDA. Ongoing engagement with the Indigenous communities will continue to take place, and they will be provided the opportunity to support the development of management and reclamation plans and/or to support reclamation activities at the site. Nonetheless, a reduction in the use of land or the resources on the land within the PDA is unavoidable throughout the life of the Project. As requested by Indigenous communities (MTI), an IKLOS study may be conducted to identify specific current traditional uses in the PDA that might require accommodation, where reasonable.

In summary, the PDA represents a small percentage of the lands in the Petitcodiac River watershed (i.e., Mi'kmaq traditional territory), and given that the PDA consists of privately owned land near commercial and residential uses and has been cleared in the past decade, subject to confirmation by Indigenous communities through engagement, it is unlikely that the Project site is considered to be important to the current practice of Indigenous traditional activities. The PDA will be inaccessible during construction and operation for such purposes, but will be restored upon closure with natural regrowth and replanting of vegetation and trees such that, at some time in the future, portions of the PDA may again provide opportunities for practicing traditional activities.

In light of the above, and with the careful implementation of environmental protection and mitigation measures, including accommodation, where reasonable, for demonstrated infringements of Aboriginal or treaty rights that might arise as a result of the Project, the residual environmental effects of the Project on traditional land and resource use during each phase of the Project are not anticipated to result in significant environmental effects on the use of land or resources by the Mi'kmaq or Wolastoqey peoples that may practice traditional activities in the LAA, subject to confirmation by Indigenous communities through engagement. This prediction is made with a moderate level of confidence due to the limited engagement of Indigenous communities conducted to date and the lack of specific information about potential traditional land and resource use activities that might be occurring (or have occurred) in the PDA. Ongoing engagement of Indigenous and a IKLOS/TLRU study as requested by MTI, may improve the level of confidence in this prediction.

There is no follow-up or monitoring proposed specifically for this VC as part of the EIA process. However, Hammond River Holdings engaged with Indigenous communities to partake in the biophysical surveys completed for preparation of this document; MTI provided a monitor for the duration of the surveys completed in 2022. MTI will also provide a monitor during the construction, operation, and reclamation phases of the project.

6.0 Effects of the Environment on the Project

The potential effects of the environment that could occur on the Project are assessed in this section.

6.1 Scope

Effects of the environment on the project are those effects related to risks of natural hazards and influences of the natural environment on the Project. Potential effects of the environment on any project are a function of project or infrastructure design in the context of its receiving environment, and ultimately how the project is affected by the natural environment. These effects may arise from physical conditions, land forms, and site characteristics or other attributes of the environment which may act on the project such that the project components, schedule, and/or costs could be substantively and adversely changed.

Based on the nature of the undertaking, the following environmental attributes have been selected for consideration in this assessment:

- climate and climate change;
- severe weather events, including wind, precipitation, floods, hail, electrical storms, and tornadoes;
- seismic activity; and,
- forest fires resulting from causes other than the Project.

6.1.1 Temporal Boundaries

The temporal boundaries for the Project include the following:

- **Construction**: extending for a period of approximately four months, anticipated to begin in the fourth quarter (Fall) of 2023 (subject to the receipt of all approvals and permits required for the Project);
- **Operation**: beginning in approximately the first quarter of 2024, and lasting for approximately 10 years or until the mineral resource has been depleted; and,
- **Reclamation and closure**: to be initiated following the completion of operations at the site, with decommissioning and reclamation of the surface facilities at the site for an anticipated duration of six months following operation.

6.1.2 Spatial Boundaries

The Project development area (PDA) is defined as the area of physical disturbance associated with construction and operation of the Project. Specifically, the PDA consists of an area of approximately 85 ha (i.e., conservatively assumed to be the entirety of PIDs 00814160, 70076948, and 70654058) that includes the open pit and all related surface facilities located on the property. The PDA is the area represented by the physical Project footprint.

As effects of the environment on the Project relates to potential influences of the forces of nature on the Project integrity and conduct, the local assessment area (LAA) for effects of the environment on the Project is limited to the PDA.

6.1.3 Significance Threshold

A significant adverse effect of the environment on the Project is defined as one where:

- damage to the Project infrastructure results in a substantial increase in risks to the health and/or safety of the public, or substantial risks of a business interruption;
- damage to the Project infrastructure results in repairs that could not be technically or economically implemented;
- a long-term interruption in service occurs (e.g., an interruption in quarrying activities such that production targets cannot be met); or,
- a substantial change of the Project schedule is experienced (e.g., a delay resulting in the construction period being extended by one season).

6.2 Existing Conditions

6.2.1 Climate and Climate Change

Climate is defined as the statistical averages of precipitation, temperature, humidity, sunshine, wind velocity, and other phenomena such as fog, frost and hail storms for a particular region and time period, generally taken over a 30-year period (NASA 2017). Climate change is an acknowledged change in climate that has been documented over two or more 30-year periods. According to the Intergovernmental Panel on Climate Change (IPCC), climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use (IPCC 2014). The United Nations Framework Convention on Climate Change (UNFCCC) makes a distinction between climate change attributed to human activities and climate variability attributable to natural causes, by defining climate change as a change of climate directly or indirectly attributed to human activity that alters the composition of the global atmosphere, and which is in addition to natural climate variability observed over comparable time periods (IPCC 2014).

The definition of climate change dictates the context in which the effects of those changes are discussed. While it is appropriate to examine the effects of projected climate change on projects with long anticipated life spans (50 to 100 years from construction into post-closure of Project), it may not always be fitting to consider the effects of climate change projections on projects which will only take place over a relatively short period of time, and to be initiated in the near future. In the case of the Project, with an anticipated lifespan of 10 years, rather than considering the effects of long-term climate change on the Project, it is more appropriate to consider the effects of recent climatological conditions, especially the potential adverse effects of weather variability and weather extremes (e.g., change in precipitation).

The technical boundaries for the establishment of climate conditions include the spatial coverage of weather stations across New Brunswick, the number of parameters monitored at each station, and the temporal coverage of data collection at each station. Technical boundaries for the prediction of effects of climate change relate to the inherent uncertainty of global climate models in predicting future changes in climate parameters, and specifically their application of global-scale prediction algorithms to a relatively localized scale through “downscaling”. Global climate models can provide relatively useful information for predicting and preparing for global and macro-level changes in climate, but their ability to pinpoint location-specific changes to climate on a localized level is limited.

Climate Normals

Current climate conditions are generally described by the most recent 30-year period for which Environment and Climate Change Canada has developed statistical summaries. These summaries are typically referred to as “climate normals”. The closest weather station to the Project with available historical data is the Turtle Creek weather station, located at the Turtle Creek surface water reservoir, approximately 26 km northeast of the PDA. Data at the Turtle Creek weather station are limited to temperature and precipitation; therefore, climate normals from the Moncton (A) weather station, approximately 46 km northeast, were also presented in **Table 5.2.2** to capture additional parameters. This period has been chosen as the most applicable period for summarizing current climate conditions for the Project (GOC 2022b; GOC 2022c).

Monthly mean wind speeds measured at the Moncton A weather station range from 13.2 to 19.2 km/h, with an annual mean wind speed of 16.8 km/h. From May to August, the dominant wind direction is southwest, with winds predominantly blowing from the southwest and west from September to February (GOC 2022c). Maximum hourly wind speeds, averaged from 1981 to 2010 for each month, range from 56 km/h to 103 km/h, while maximum wind gusts for the same period range from 89 km/h to 161 km/h. Occurrences of extreme winds are relatively uncommon at the reference weather station. From 1981 to 2010, there has been an average of 23.6 days per year with winds greater than or equal to 52 km/h and 6.4 days per year with winds greater than or equal to 63 km/h (GOC 2022c).

Precipitation at the Turtle Creek reservoir, on average, is highest from Spring to early Summer and Fall through the early Winter period. From 1981 to 2010, the reference region has received an average of 1,094.2 mm of precipitation per year, of which 823.3 mm was rain and 270.9 mm was snowfall (as water equivalent). Extreme daily precipitation in the past century has ranged from 48.0 mm (January 1992) to 110.2 mm (July 1972). On average, there have been 5.9 days each year with rainfall greater than 25 mm, and snowfalls greater than 25 cm occur on average 1.6 days each year (GOC 2022b).

The annual daily average temperature at the Turtle Creek reservoir weather station during the period of 1981-2010 was 5.6 °C, while the average daily maximum was 10.9 °C and the average daily minimum temperature recorded was 0.3 °C. The extreme maximum temperature was 35.0 °C recorded on May 22, 1992 and the extreme minimum temperature was -35.5 °C recorded January 5, 1981 (GOC 2022b).

6.2.2 Severe Weather Events

Extreme precipitation and storms can occur in New Brunswick throughout the year but tend to be more common and severe during the winter. Winter storms generally bring high winds and a combination of snow and rain, especially in low lying areas near the Bay of Fundy.

Extreme rainfall events occur when 50 mm or more rain falls over a 24-hour period. Environment Canada issues a rainfall warning when this is forecast to occur. In the 2000s, Fredericton and Moncton had more extreme rainfall events than other decades on record, while Saint John had the highest number of events during the 1960s. The trends were different in each of the three communities. Recently, extreme storm events in December 2010 affected much of New Brunswick, where some areas received as much as 200 mm of rain; these events threatened public safety and transportation systems, and damages were estimated to be approximately $50 million (NBDELG 2022e).

In New Brunswick, river valleys and flood plains can pose a risk because of ice jams, harsh weather and the floods of annual spring thaw. Flooding in New Brunswick is rather common, especially along the Saint John River (ECCC 2017). While the North River, located adjacent the Project site, is not known as being highly flood prone, ice jams and localized flooding are possible during spring freshet.

Significant ice storms have affected New Brunswick twice in the past 10 years. The December 2013 ice storm saw the southern region hardest hit (Atlantic Security Group Inc. 2014); however, in January 2017, a significant ice storm affected eastern and northeastern New Brunswick extending from the Acadian Peninsula to the New Brunswick-Nova Scotia border. According to NB Power, between 50 and 100 mm of ice built up on trees and power equipment in the Acadian Peninsula. Ice buildup led to significant damage to NB Power equipment and transmission/distribution infrastructure, as well as impassable roads, wide-spread power outages, and health emergencies (GNB 2017).

Electrical storms, or thunderstorms, which are more frequent in New Brunswick than the rest of Atlantic Canada, occur on average 10 to 20 times a year (NAV Canada 2001). Generally, only one of these storms (per year) is extreme enough to produce hail. Thunderstorms can produce extremes of rain, wind, hail and lightning; however, most of these storms are relatively short-lived.

Tornadoes are rare in New Brunswick, but can occur. Across Canada, Tornadoes occur most frequently in two areas - from southern Alberta across southern Saskatchewan and southern Manitoba to northwestern Ontario, and from southern Ontario across southern Quebec to New Brunswick. These areas are extensions of tornado-active areas in the United States, though separated by an area of low frequency caused by the stabilizing influence of the relatively cool Great Lakes (Western University 2022).

6.2.3 Seismicity

Seismic activity is dictated by the local geology of an area and the movement of tectonic plates comprising the Earth's crust. Natural Resources Canada monitors seismic activity throughout Canada and identifies areas of known seismic activity in order to document, record, and prepare for seismic events that may occur. The Project area is located in the Northern Appalachians Seismic Zone, which includes most of New Brunswick and extends into the northeastern United States, as far south as Boston, Massachusetts. Historical seismic data recorded throughout this zone has identified clusters of earthquake activity. However, historical seismic activity is considered low (Natural Resources Canada 2018). Earthquakes in New Brunswick generally cluster in three regions: the Central Highlands (near Miramichi) region, the Moncton region, and the Passamaquoddy Bay region in the southwestern corner of the province.

The largest recorded earthquake ever recorded in New Brunswick was a magnitude 5.7 (on the Richter scale) event on January 9, 1982, located in the north-central Miramichi Highlands. Aftershocks following this earthquake reached magnitude 5.1 and 5.4. Between 1855 and 1937, other moderate earthquakes in these three regions, ranged from 4.5 to 6.0 (Basham and Adams 1984). The maximum credible earthquake magnitude for the northern Appalachians region is estimated to be magnitude 7.0, based on historical earthquake data and regional tectonics (Adams and Halchuk 2003). It is noted that there is potential for large earthquakes of up to an estimated magnitude 7.5 along fault zones in the St. Lawrence River region. However, such events in this region would be close to 400 km from the Project site, and therefore the amplitude of ground motions at the Project site would be low due to attenuation over a large distance. Further, there is limited infrastructure associated with this Project that would be susceptible to a seismic event.

Based on the low frequency of recorded earthquakes in the region, and, therefore, low probability that a major seismic event would occur in the immediate vicinity of the Project during the Project's lifespan, major Project damage or interruption to activities due to earthquakes during any phase of the Project is considered to be low. Therefore, seismicity was not carried forward for further consideration under the Effects Assessment for this Project.

6.2.4 Forest Fires

The Fire Weather Index is a component of the Canadian Forest Fire Weather Index System. The index provides a numeric rating of fire intensity, and is the general index of fire danger throughout the forested areas of Canada (Natural Resources Canada 2022a).

The mean Fire Weather Index in Glenvale, New Brunswick for the month of July (i.e., normally the driest month of the year), when risk of forest fire is typically greatest, was mostly 0-5, as shown in **Figure 6.2.1**, which is the lowest rating on the scale of possible fire risk. This risk is based on Fire Weather Normals data, representing the average value of a fire weather code or index over the 30-year period from 1981 to 2010 (Natural Resources Canada 2022a).

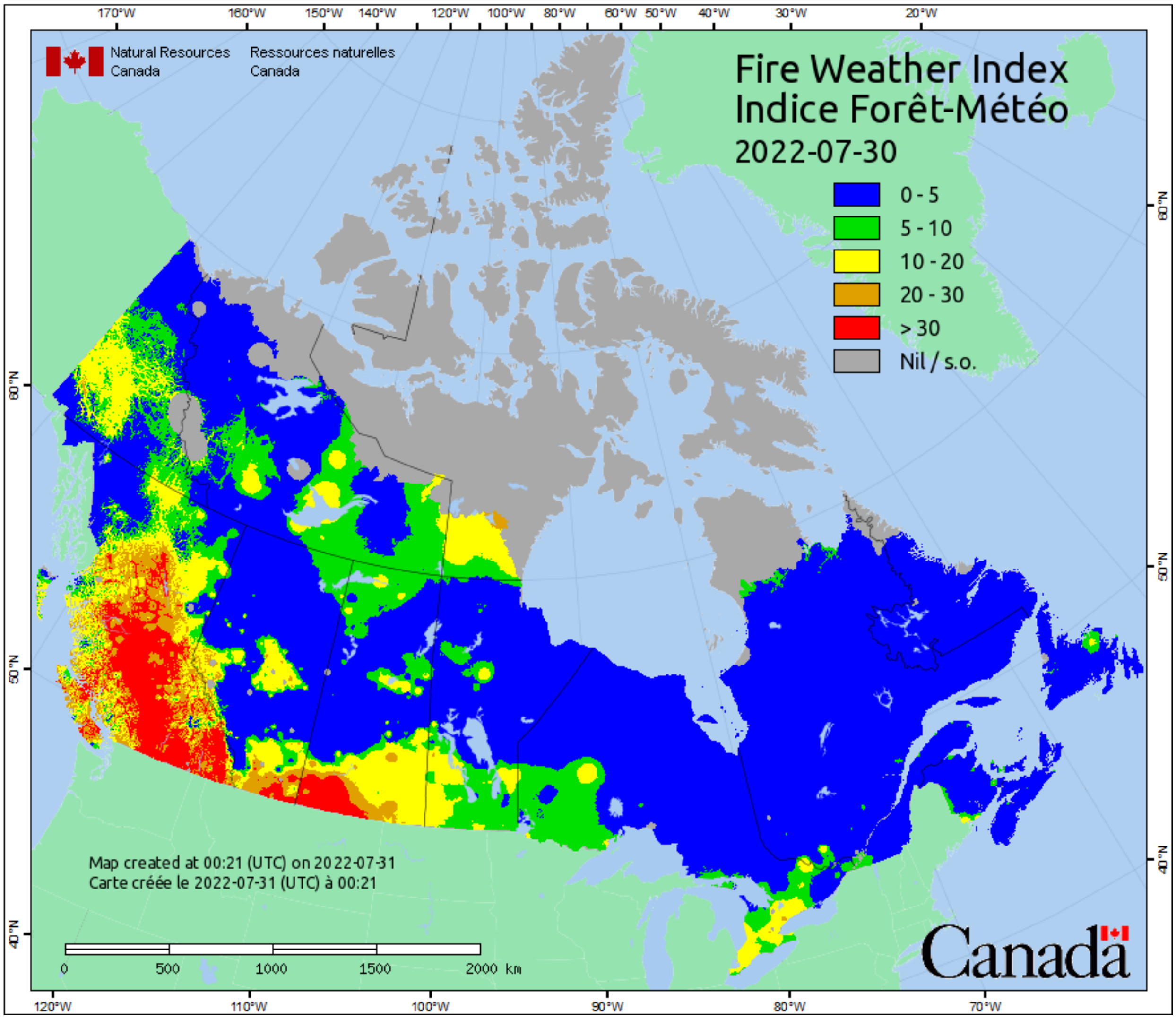


Figure 6.2.1: Natural Resources Canada Fire Weather Index

6.3 Effects Assessment

As a factor of safety, and a matter of responsible engineering practice, the design and materials to be chosen for construction of the Project will be selected so that the Project will withstand environmental stressors that could occur from various natural and environmental phenomena (e.g., extreme storms, increased precipitation and other factors arising from climate change, and others). The EIA has been carried out in parallel to Project design, and the results of the EIA have informed the design of the Project such that potential concerns are addressed and the potential for significant adverse effects of the environment on the Project is minimized.

The Project will be constructed to meet all applicable building, safety and industry codes and standards.

The engineering design of the Project will consider and incorporate potential future changes in the forces of nature that could affect its operation or integrity (e.g., climate change), and Project components and infrastructure will be designed and built to adapt to or withstand these effects.

Design requirements address issues associated with environmental extremes including:

- storm water drainage from rain storms and floods; and,
- erosion protection of slopes, embankments, ditches and open drains.

6.3.1 Potential Effects

Effects of Climate and Climate Change and Extreme Weather on the Project

To assess the environmental effects of climate on the Project, current climate and climate change must both be considered. Current climate conditions have been established by compiling relevant historical data and establishing a climatological background for the Glenvale, New Brunswick area. Climate change effects projected over the life of the Project are determined through reviewing the climate modelling research to establish the current state of understanding of likely trends in the Glenvale area over the next 50 to 100 years. However, as noted in **Section 6.2**, since the Project has an anticipated lifespan of only 10 years, rather than placing the most emphasis on the effects of long-term climate change on the Project, it is generally more appropriate to consider the effects of recent climatological conditions, especially the potential adverse effects of weather variability and weather extremes (e.g., change in precipitation).

Numerous climate-related conditions, linked primarily to global warming, have been observed across Atlantic Canada, the entire country and globally. These changes to the climate regime will continue to accelerate over the next century, as has been the case with global temperatures over the past two decades (IPCC 2014). Several changes in conditions have been projected to affect infrastructure in Atlantic Canada in the future, including changing precipitation patterns, higher temperatures, more storm events, increasing storm intensity, erosion and flooding.

The relatively short period of construction and the anticipated period of operation for the Project is not considered as a period over which the effects of future climate change can or should be considered. Rather, it is more important to consider recent climate trends (1981-2010 averages and extremes) and assess the likelihood and effect of severe and extreme weather events on the Project so that they may be accounted for in the design, construction, operation, and eventual reclamation and closure processes and timelines. The most relevant climate changes that could potentially have effects on the Project include:

- increased frequency and magnitude of heavy precipitation events; and,
- increased frequency of extreme storms accompanied by heavy and/or freezing precipitation, thunderstorms, and strong winds; and increased incidence of flooding and erosion.

Each of these effects must be considered in terms of how they may adversely affect the Project if they are not planned, engineered, and designed to account for such effects. The environmental attributes described have the potential to affect the Project in several ways, including but not limited to:

- a reduction in visibility and an inability to manoeuvre construction and operational equipment;
- changes to the ability of workers to access the work site (e.g., poorly designed culverts, erosion and road wash outs);
- damage to construction equipment and site infrastructure;
- increased structural loading from snow and ice build-up; or,
- reduce the ductility of construction materials used in Project components (e.g., weigh scale and associated building), and increase susceptibility to brittle fracture.

Extreme snowfall can also affect winter construction and operation by causing a delay in delivery of materials, and resulting in additional effort for snow clearing and removal. This additional effort, however, would not substantially change the Project schedule. Extreme snowfall contributing to unusual flooding during snowmelt and extreme rainfall events could also potentially lead to flooding and erosion. Heavy rain, snowfall and/or freezing rain events could also cause an interruption of services such as communications or on-site electrical power if power to site facilities (e.g., portable trailer/office) is primarily supplied by on-site solar panels.

During electrical storms, fault currents (defined as a current that is several times larger in magnitude than the current that normally flows) may result from a lightning strike and could result in danger to personnel and damage to infrastructure (e.g., weigh scale). Since a power line is not essential to the Project, it is not anticipated that lightning strikes will result in power outages.

Some effects, such as damage to infrastructure, can also result in consequential effects on the environment. These types of environmental effects are addressed as Accidents, Malfunctions, and Unplanned Events in **Section 7.0**.

Based on the low frequency of recorded earthquakes in the region, and, therefore, low probability that a major seismic event would occur in the immediate vicinity of the Project during the Project's lifespan, major Project damage or interruption to activities due to earthquakes during any phase of the Project is considered to be low.

Effects of Forest Fires on the Project

With respect to the effects of forest fires on the Project, Project-related equipment and vehicles could be damaged by extreme heat. Smoke generated by forest fires could adversely affect project personnel resulting from reduced air quality. The Project is situated within a sparsely developed region in central New Brunswick where forest fires are not uncommon.

Aerial imagery indicates that the forests surrounding the PDA area have been subject to varying degrees of harvest and silviculture related to forest harvest practices. Fire behaviour normals mapping (Natural Resources Canada 2022b) indicates that the mean rate of spread of fire in the Project area is between one and three metres per minute. The rate of spread is based on several factors including fuel type, forest health, and crown base height. The mean rate of spread for the Project area is the second lowest on the scale used by Natural Resources Canada.

New Brunswick has a forest fire control program in place to identify and control fires, minimizing the potential magnitude and extent of forest fires, and their potential consequent effects on the Project. Local and provincial emergency response crews will provide for rapid detection and response to identified fire threats. This includes fires that could start within the Project site perimeter as well as fires approaching from outside the area (i.e., forest fires). In addition, the large open cleared area (i.e., the open pit) provides a safety and fire buffer, further decreasing the likelihood of a forest or brush fire causing substantive damage to the Project. The on-site trailers and truck scale are also situated in an open field which offers greater protection against fire damage. Structures located in open grassy fields are more easily protected by emergency personnel by use of scratch lines or fire breaks to halt the advance of a grass fire before they reach structures. Furthermore, gypsum rock itself is inert and non-flammable, conversely its high-water content may provide fire-resistant properties and additional protection against substantive damage.

With respect to the effects of forest fires on the Project, the facility structures will be constructed primarily of concrete, asphalt, metal and steel (e.g., weigh scale, site trailer), which are not typically affected by fire, and the majority of materials handled (e.g., topsoil, grubbings, waste rock) are not flammable. Petroleum products, explosives, and other highly flammable substances are not planned to be stored at the PDA.

6.3.2 Mitigation

Mitigation strategies for minimizing the likelihood of a significant adverse effect of the environment on the Project are inherent in: the planning process being conducted, the application of engineering design codes and standards, construction practices, and monitoring. To address these environmental effects, proactive design, planning, and maintenance are required in consideration of the potential normal and extreme conditions that might be encountered throughout the life of the Project.

Mitigating Effects of Climate and Extreme Weather on the Project

- Disruption of Project activities and delays to the Project schedule will be avoided by scheduling tasks that require precise and/or timely movements (e.g., storage area development, storm water management pond development) for periods when the weather conditions are favourable. A disruption allowance will be considered in Project and operational scheduling.
- Extreme precipitation events are an expected work condition and the Project schedule allows for weather conditions typical for the Southern New Brunswick region. The Project will account for storm allowances (i.e., 1-in-100-year 24-hour flood event). These allowances are sufficiently

conservative to account for extreme weather events and to take into account increase in the frequency and/or severity of significant storm events that might arise from climate change over the life of the Project. As such, site water management features will be in place early in the construction phase to manage potential increased site run-off from precipitation events that could occur.

- Erosion as a result of extreme precipitation and potential flooding is not anticipated to have a substantive adverse effect on the Project due to standard mitigation measures that will be implemented (e.g., collection and management of site water, use of erosion and sedimentation control structures, construction methods that stabilize erodible soils as early as possible after ground has been disturbed). Following construction, exposed soils will be stabilized, roadways will use suitable gravel bases and sub-bases to prevent erosion, and exposed areas will be vegetated where possible to prevent surface erosion.

Mitigating Effects of Forest Fires on the Project

The Project and related infrastructure, including the facility structures will be constructed primarily of concrete, asphalt, metal and steel (e.g., weigh scale, portable trailer), which are not typically affected by fire, and the majority of materials handled (e.g., topsoil, grubbings, waste rock) are not flammable. Petroleum products, explosives, and other highly flammable substances are also not planned to be stored at the PDA.

Through integrated and coordinated emergency response capabilities at the local and provincial levels, project personnel will mobilize away from the PDA if forest fires are affecting the local area, and will only return under clear and safe conditions, as determined by emergency response agencies in the province.

6.3.3 Characterization of Residual Effects

The potential effects of the environment on all project phases will be considered in the planning and design of the Project and in the scheduling of Project activities to limit delays, prevent damage to infrastructure and the environment, and to maximize the safety of staff. Compliance with regulatory standards are expected to account for weather extremes, and forest fire threats through built-in factors of safety to prevent undue damage to infrastructure from such events. Although it is possible, even likely, for the PDA to experience extreme environmental conditions during the Project lifecycle, a substantive delay (e.g., a delay for more than one season) is not anticipated.

Further, no substantial damages to Project infrastructure are anticipated as a result of natural environmental conditions due to the design and type of activities proposed. Therefore, the effects of the environment are not expected to adversely affect the Project in a manner that cannot be planned for or accommodated through design and other mitigation and adaptive management strategies. As a result, the effects of the environment on the Project are expected to be not significant.

6.4 Summary

As a matter of generally accepted engineering practice, responsible and viable engineering designs tend to consistently overestimate and account for possible forces of the environment, and thus inherently incorporate several factors of safety so that a project is designed to be safe and reliable throughout its lifetime.

For the Project, long-term environmental management and Project longevity (up to 10 years) are inherent considerations in the best management practices of the design and associated Project risk management. Equipment and materials that are able to withstand severe weather and other influences will be used. Environmental stressors, such as those that could arise as a result of climate change, severe weather, or other factors would more than adequately be addressed by good planning, materials selection, best practices, and engineering foresight. As will be demonstrated, while there is potential for natural forces to affect the Project, it is not likely to have a substantive effect due to planned mitigation and design.

Hammond River Holdings will continue to monitor changing information regarding climate change and design, and operations will be managed adaptively so that the effects of the environment on the Project will be mitigated if new situations develop. Accordingly, the effects of the environment on the Project are considered not significant.

7.0 Accidents, Malfunctions, and Unplanned Events

This section identifies accidents, malfunctions, and unplanned events that may occur during the proposed project's lifespan. The assessment focuses on events that are considered credible based on the Project description and the experience of the EIA team in assessing similar projects.

7.1 Approach

The general approach to assessing the potential environment effects of the selected potential accident, malfunction, or unplanned event scenarios involves the following:

- describing the potential accident, malfunction, or unplanned event;
- considering if the potential accident, malfunction, or unplanned event could occur during the life of the Project, and during which phase(s) or activity(ies);
- determining with which valued component(s) (VCs) the potential accident, malfunction, or unplanned event may interact;
- describing the Project planning and safeguards established to minimize the potential for such occurrences to happen;
- considering of the contingency or emergency response procedures applicable to the event; and,
- in consideration of the above, assessing the residual environmental effects of accidents, malfunctions, and unplanned events on related VCs, and determining the significance of the potential residual environmental effects of these accidents, malfunctions, or unplanned events (and their likelihood of occurrence, as applicable).

Spatial and temporal boundaries for considering residual environmental effects of potential accidents, malfunctions, and unplanned events that may arise as a result of the Project are the same as those for each VC to which they apply, presented earlier in this document. Similarly, criteria used for determining the significance of residual environmental effects with respect to potential accidents, malfunctions, and unplanned events are the same as those for each applicable VC.

7.2 Description of Potential Credible Accidents, Malfunctions, and Unplanned Events

Based on the nature of the Project, knowledge of the environment within which the Project is located, as well as the experience of the Proponent, the following credible accidents, malfunctions, and unplanned events have been selected for this assessment, and are described in greater detail in the following sections.

Slope Failure: A slope failure may occur due to two principal reasons: failure of working faces of the open pit due to improper design and/or operational procedures; or failure of overburden slopes above the working face. Improperly designed and operated open pits could result in a slope failure that could pose a safety hazard to workers or damage to equipment located within the quarry during construction or operation.

Failure of an Erosion and Sediment Control (ESC) Measure: Erosion and sedimentation control (ESC) measures prevent exposed soil from mobilizing and entering undisturbed areas as a result of rainfall or spring runoff. This event includes a structural failure of the water management pond (settling pond) on-site. A failure of an ESC measure could result in mass wasting of soil or siltation of receiving watercourses. The discharge of sediment to watercourses during storm events or spring runoff following the failure of an ESC measure could occur during the construction or operation phases of the Project.

Uncontrolled Detonation: Explosives will be periodically used to blast rock from the open pit during the operation phase. An uncontrolled explosion refers to either the timing of the explosion (i.e., premature or late detonation) or the magnitude of the blast beyond what was planned. An uncontrolled explosion could pose a risk to the safety of workers on site or the public, or cause damage to equipment or property, either as a result of the force of the blast or from fly rock arising from it. An uncontrolled explosion could only occur during the operation phase of the Project. Note, explosives will not be stored on the Project site.

Vehicle Accident: A vehicle accident is possible during the construction or operation phases at the proposed quarry site or in transit on provincial roads. A vehicle accident includes a collision with other vehicles, pedestrians, wildlife, or structures/objects, and potentially pose a risk to the health and safety of workers, the public, or wildlife. A fire or fuel spill could also occur as a consequence of a vehicle collision, compounding the initial effects by potentially threatening surface water, groundwater, fish and fish habitat, wildlife and wildlife habitat, vegetation, and wetlands.

Accidental Release of a Hazardous Material: An accidental release of fuel used in vehicles or mobile equipment on-site may occur during refuelling of machinery or trucks as a result of human error or equipment malfunction, potentially affecting surface water, groundwater, fish and fish habitat, wildlife and wildlife habitat, vegetation, and wetlands. Refuelling of on-site equipment will be by mobile delivery trucks on a daily basis during construction and operation phases of the Project.

Discovery of a Heritage Resource: Previously undiscovered archaeological resources (i.e., artifacts) could be uncovered during excavation of topsoil and overburden as well as from other earth moving activities on the site during the construction phase. Similarly, if present, palaeontological resources (i.e., fossils) could be uncovered during gypsum extraction in the operation phase of the Project as the underlying bedrock (gypsum) is exposed for removal.

7.3 Potential Interactions between Accidents, Malfunctions, and Unplanned Events and Related Valued Components

Based on the nature of the above credible events and the study team's knowledge of their potential to interact with the environment, the VCs with a reasonable potential to interact with these potential accidents, malfunctions, or unplanned events that could result in residual environmental effects are identified in **Table 7.3.1**.

Table 7.3.1: Potential Interactions of Accidents, Malfunctions, and Unplanned Events with Valued Components

Accident, Malfunction, or Unplanned Event	Atmospheric Environment	Water Resources	Fish and Fish Habitat	Vegetation and Wetlands	Wildlife and Wildlife Habitat	Agricultural and Livestock	Socioeconomic Environment	Heritage Resources	Traditional Land and Resource Use
Slope Failure							✓		
Failure of an Erosion and Sediment Control Measure		✓	✓	✓	✓	✓			✓
Uncontrolled Explosion							✓		
Vehicle Accident	✓	✓	✓		✓	✓	✓		
Accidental Release of a Hazardous Material	✓	✓	✓	✓	✓	✓			✓
Discovery of a Heritage Resource								✓	

Legend: ✓ indicates a potential interaction

Those accidents, malfunctions, or unplanned events that may result in an interaction with a specific VC are identified with a checkmark in the table above, and are therefore carried for further assessment below.

Accidents, malfunctions, or unplanned events that are not identified with a checkmark in the table above are not expected to result in an interaction with a specific VC or VCs. For those accidents, malfunctions, or unplanned events, the residual environmental effects of the Project with the VCs for which an interaction was not identified in the above table during each phase are not significant, with a high level of confidence.

7.4 Assessment of Potential Environmental Effects from Accidents, Malfunctions, and Unplanned Events

This section assesses the environmental effects of each of the credible accidents, malfunctions, and unplanned events for which an interaction was identified with a related VC (or VCs), and identifies mitigation measures to address the potential residual environmental effects. The significance of potential residual environmental effects following the implementation of mitigation or consideration of emergency or contingency response procedures is also discussed.

7.4.1 Slope Failure

A slope failure could pose a risk to workers or equipment within the working area of the Project (particularly within the open pit), or may lead to worker injury or possibly death as well as damage to equipment. Potential related effects could include interruption or suspension of quarry operations during investigations by regulating agencies. Such an interruption could cause an adverse effect on the socioeconomic environment.

7.4.1.1 Mitigation

Key mitigation to prevent a slope failure includes:

- Slope angles established using industry standard practices and methods;
- The Project will be constructed and operated in accordance with provincially regulated overburden setbacks and pit face angles for removal of material;
- Operation of the open pit will be in compliance with the *General Regulation* 91-191 under the New Brunswick *Occupational Health and Safety Act*;
- A site specific safety plan will be developed to address the due diligence requirements with respect to the quarry face stability; and,
- An Emergency Response Plan will be in place as part of the Environmental Protection Plan (EPP) for the Project.

7.4.1.2 Potential Residual Environmental Effects

The risk of slope failure during the construction or operation of the Project is expected to be low with the implementation of good working practices and preventative measures, and adherence to applicable provincial regulations and guidelines for the safe operation of quarries.

With preventive and mitigative measures, safe working practices, compliance with occupational health and safety legislation, and the low probability of slope failure, the potential residual environmental effects of a slope failure on the socioeconomic environment during construction and operation of the Project are not significant, with a high level of confidence.

7.4.2 Failure of an Erosion and Sediment Control Measure

Erosion and sediment control (ESC) measures prevent erosion of surface soils and the resulting surface runoff from directly entering surface water bodies. A failure of an ESC measure could be a result of the measures being insufficient to manage a given runoff event (e.g., rainfall or spring runoff exceeding capacity) or the implementation was poorly constructed.

A failure of an ESC measure could affect primarily fish and fish habitat. The discharge of runoff containing sediment to watercourses during storm events or spring runoff could result in the degradation of adjacent surface water bodies, wetlands, and fish and fish habitat those environments support. The effects on fish and fish habitat could include a temporary reduction in water quality due to increased sediment load. If the release were to occur during spawning, spawning beds could be negatively affected as sediment may cover the gravel beds and suffocate the eggs. Aquatic organisms may be adversely affected by a sediment release, potentially reducing the fish's food supply. Further, degradation in water quality could impact livestock that use the impacted waterbody as a drinking water source, as well as farmers who use the water to irrigate their farmland.

In addition, a failure of an ESC measure could affect traditional land and resource use as a consequential environmental effect. Indigenous communities that practice traditional activities near the Project site could be affected if the fish and fish habitat affected by an ESC failure were being used for traditional purposes.

7.4.2.1 Mitigation

Key mitigation to prevent a failure of erosion or sedimentation control measures includes:

- Contingency plans will be developed for extreme rainfall or spring runoff events including:
  - monitoring of surface runoff conditions during heavy rainfall/spring runoff and operational observations to evaluate the need for improvements in surface runoff control;
  - cover will be applied to highly erodible areas;
  - clean-out of settling ponds and check dams will be conducted, and,
  - provision of a stockpile of sediment and erosion control materials.
- Contingency may also include temporary pumping of surface water back into the open pit if temporary inflow of water to the pit floor during storm events is not an operational concern.
- A Project-specific Environmental Protection Plan (EPP) with defined contingency and emergency response procedures in the event of a failure of an ESC measure will be developed and implemented.

Note that approaches will vary depending upon season, and the Site Manager shall indicate approaches for summer low flow periods, spring-fall high flow periods, and frozen ground high flow periods.

7.4.2.2 Potential Residual Environmental Effects

The installation, maintenance, and monitoring of erosion and sedimentation control structures is a routine activity on construction sites and industrial operations, and is well understood by site managers and construction personnel. With daily visual monitoring of erosion and sedimentation control devices, conducting maintenance of them as necessary, periodically removing accumulated sediment, and active water management on-site, the risk of a failure of erosion and sediment control measures occurring is expected to be low. With the implementation of mitigation measures, contingency and emergency response procedures, and best practices, the potential residual environmental effects of a failure of an erosion and sedimentation control measure on surface water, fish and fish habitat, vegetation and wetlands, wildlife and wildlife habitat, and traditional land and resources during all phases of the Project are not significant, with a high level of confidence.

7.4.3 Uncontrolled Detonation

An uncontrolled explosion has the potential to interact with the socioeconomic environment. An uncontrolled explosion has the potential to injure or kill workers on the site, damage equipment or machinery at the Project site as a result of the force of an explosion. An uncontrolled explosion also has the potential to injure or kill people and damage property off-site as a result of fly rock. Fly rock is rock ejected from an explosion that travels outside the blast site and can vary in size and distance travelled. Minor consequential environmental effects could occur to the atmospheric environment and possibly wildlife and wildlife habitat.

Incidents related to uncontrolled blasts could result in interruptions in operations at the Project site, in addition to other potential consequences.

7.4.3.1 Mitigation

Key mitigation to prevent an uncontrolled explosion includes:

- Explosives will be transported to the Project site by a licensed blasting subcontractor on a daily basis.
- The contractor will follow a blasting schedule laid out by the Site Manager.
- Only licensed blasting contractors with the appropriate qualifications for the nature of the Project activities will be used.
- Blasting activities will be limited to approximately 25 blasts per year as an annual average (excluding nights, weekends, and statutory holidays), and a communication plan will be developed for residents who wish to be notified.
- An audible alarm will be sounded prior to all blasts to provide advance warning to workers and residents, in accordance with *General Regulation* 91-191 under the New Brunswick *Occupational Health and Safety Act*.

- Pre-blast surveys will be conducted at the nearest residences, and blasts will be periodically monitored using seismographs to confirm that concussion noise levels do not exceed a peak pressure level limit of 128 decibels (dBL) and that peak particle velocities (PPV) remain within 1.25 cm/s, as a best industry practice for quarry operations.
- Transportation of explosives will be in compliance with the federal *Explosives Regulations* under the *Explosives Act* and the *Transportation of Dangerous Goods Regulations* under the *Transportation of Dangerous Goods Act*.
- Blasts will be carried out in sequence using best available industry techniques for avoiding the risk of an uncontrolled explosion (including fly rock).
- The risk of an uncontrolled explosion will be further reduced by the use of current technologies, best industry practices, and strict legislative requirements through regulatory requirements or permitting.
- A Blast Monitoring Plan will be developed to identify the appropriate procedures and monitoring requirements to be implemented during blasting activities.

7.4.3.2 Potential Residual Environmental Effects

The use of explosives on an industrial site for quarrying operations by experienced licensed blasting contractors is a routine activity that is well understood and managed in a manner to prevent the risk of uncontrolled explosions. Additional mitigation measures to be implemented as part of the Project are expected to further reduce the likelihood of an uncontrolled explosion. With these measures and the relative distance between the Project site and the nearest residences, the risk of an uncontrolled explosion is expected to be negligible. With the implementation of mitigation measures, contingency and emergency response procedures, and best practices, the potential residual environmental effects of an uncontrolled explosion on the socioeconomic environment during each phase of the Project are not significant, with a high level of confidence.

7.4.4 Vehicle Accident

A vehicle accident could affect the socioeconomic environment, the atmospheric environment, water resources, fish and fish habitat, wildlife and wildlife habitat, and/or agricultural land and livestock.

Vehicles will be active across the Project site throughout the construction and operation phases as well as on the transportation route between Glenvale and East Saint John. Vehicle collisions have the potential to risk human health and safety and other property such as project infrastructure or private property. This could have an adverse effect on the socioeconomic environment.

Consequential environmental effects of a vehicle accident could occur on the atmospheric environment, as fires or fuel spills arising from a vehicle accident could result in a temporary and localized reduction in air quality. Fuel spills resulting from a vehicle accident could adversely affect water resources or fish and fish habitat, as surface or groundwater resources may become contaminated by fuel, potentially threatening potable water supplies and fish and fish habitat. Finally, a vehicle accident could have a direct effect on wildlife, cattle, or agricultural land in the event of direct vehicle collision, and an indirect effect in the event of a fuel spill or fire resulting from a vehicle collision.

7.4.4.1 Mitigation

Key mitigation to prevent a vehicle accident includes:

- The preferred transportation route was chosen to use roads that are designed to accommodate the vehicle weights that will be associated with the Project and by accessing the four-lane Route 1 for much of the transportation route length, thereby minimizing trucking time on smaller provincial roads;
- Vehicles travelling to and from the Project site will adhere to posted speed limits, weight restrictions, and other traffic safety rules, and drivers will adjust their speed to conditions accordingly;
- Drivers will also heed wildlife warning signs and reduce speed in areas identified as posing a potential risk of wildlife collision;
- Safety zones with posted speeds will be identified throughout the Project site;
- Pedestrian zones will be identified to allow workers access throughout the work area on foot;
- Signage will be erected along Route 890 and Route 885, indicating that it is a trucking route;
- A communications plan will be established to engage with local communities potentially affected by Project-related traffic; and,
- A Project-specific Environmental Protection Plan (EPP) with defined contingency and emergency response procedures in the event of a vehicle accident will be developed and implemented.

7.4.4.2 Potential Residual Environmental Effects

Though vehicle accidents may occur with any project, particular attention will be paid to conducting Project operations in a careful and safe manner so as to reduce the risk of a serious vehicle accident. With the implementation of mitigation measures, contingency and emergency response procedures, and best practices, the potential residual environmental effects of a vehicle accident on the socioeconomic environment, atmospheric environment, water resources, fish and fish habitat, and wildlife and wildlife habitat during all phases of the Project are not significant, with a high level of confidence.

7.4.5 Accidental Release of a Hazardous Material

The accidental release of a hazardous material through spills could affect primarily water resources and fish and fish habitat, with consequential environmental effects possible to the atmospheric environment, vegetation and wetlands, wildlife and wildlife habitat, and traditional land and resources.

Other than for small quantities of emulsion explosives (which are viscous and do not readily flow) which will be carefully managed by a licensed explosives contractor on a daily basis, and the amount of fuel and lubricants present within mobile equipment on-site, there are no liquid hazardous materials anticipated to be present on-site. Though no hazardous materials or liquid fuels will be permanently stored on the Project site, vehicles and mobile equipment used to carry out earth moving, excavation, loading, hauling, and transportation operations on-site will need to be refuelled on a daily basis for their continued operation. Fuels will be brought on-site daily by mobile tankers operated by approved refuelling contractors, and refuelling activities will be carried out in a designated area (at least 30 m away from watercourses or wetlands) using defined procedures to prevent the occurrence of a spill.

An accidental spill of hydrocarbons or other substances during construction and operation of the Project may contaminate air, soils and groundwater and, through runoff, contaminate watercourses. Contaminants may adversely affect both terrestrial and aquatic habitat and migratory birds. Loss of petroleum hydrocarbons, hazardous materials, or other substances may volatilize and adversely affect ambient air quality on a temporary and localized basis.

Chemical and fuel spills may enter a watercourse directly, potentially affecting water quality and fish and their habitat, with the extent of effects depending upon the nature of the material and the quantity released. The effects could range from a small localized spill, which is contained and remediated quickly, to a large release of a highly soluble material that affects the receiving watercourse and downstream watersheds. Possible negative affects to fish and fish habitat could include direct mortality of fish and aquatic organisms that fish feed upon, degradation of surface water quality, and potential injury or death of wildlife in the event of exposure. If natural resources affected by a spill are used for traditional purposes by Indigenous persons, a consequential environmental effect of a spill could also occur to traditional land and resource use.

Effects on vegetation and wetlands from an accidental hazardous materials release include a physical harm or death of vegetation species, a reduction or loss of wetland function as a habitat for fish and wildlife, and accretion of contaminants in wetland sediments. Contaminants are less likely to move through a wetland system at the same rate as riparian systems due to the low mobility of water and sediments. Contaminants may build up in the sediments and be released into the ecosystem over time, rather than being flushed out over a season as with a riparian system.

Effects on agricultural land and livestock from an accidental hazardous materials release include loss of agricultural land use or degradation of water quality used for irrigation or livestock drinking supply.

7.4.5.1 Mitigation

Key mitigation to prevent an accidental release of a hazardous material includes:

- A Project-specific Environmental Protection Plan (EPP) with defined contingency and emergency response procedures in the event of a hazardous material spill will be developed and implemented.

- Diesel exhaust fluid (DEF) will be the only chemical stored on-site as the project does not require chemicals for processing materials. Fuel will be brought to the site by mobile tankers on a daily basis for vehicle refuelling in a designated area, and leave the site following the refuelling activities.
- A Spill Contingency Plan will be developed as part of the EPP for substances anticipated to be brought on-site during the construction and operations activities.
- Fuelling operations will be conducted in designated areas located at a minimum distance of 30 m from wetlands and surface water bodies.
- Vehicle maintenance, including the changing of oil and lubricants, will not be permitted on-site.
- Releases potentially caused by motor vehicle accidents are addressed initially by local emergency response agencies and directed by the NBDELG. Subsequently, site contractors will contain the spill and remove contaminated soils and sediment for disposal.
- Emergency spill kits will be available on-site.
- Small spills can typically be cleaned up effectively with minimal long-term impacts, and larger spills are not likely to occur based on limited quantities of hydrocarbons anticipated to be present on-site during construction/operation.

7.4.5.2 Potential Residual Environmental Effects

With no planned storage of liquid hazardous materials on-site and careful implementation of best practices during refuelling of equipment from mobile tankers on a daily basis, the risk of spills resulting during construction or operation of the Project is expected to be low. The risk of contamination from spills and leaks during the operation phase will be reduced further by preventive measures, contingency planning and spill response and mitigation. With the implementation of mitigation measures, contingency and emergency response procedures, and best practices, the potential residual environmental effects of an accidental release of a hazardous material on the atmospheric environment, water resources, fish and fish habitat, vegetation and wetlands, wildlife and wildlife habitat, and traditional land and resource use during each phase of the Project are not significant, with a high level of confidence.

7.4.6 Discovery of a Heritage Resource

The discovery of a heritage resource would interact with the heritage resources VC.

Any ground breaking or earth moving activity has the potential to uncover previously undiscovered heritage resources. Archaeological resources (i.e., artifacts) tend to be found in surficial soils and when discovered, whereas palaeontological resources (i.e., fossils) tend to be found in bedrock. The discovery of these resources can provide valuable information about human activity or use in the distant past (in the case of artifacts), or the presence of wildlife and vegetation in earlier eras (in the case of fossils). With respect to the Project, it is possible that previously undiscovered heritage resources in the form of artifacts could be found in the surficial soils (including topsoil and overburden) during construction or operation of the Project. Moreover, it is possible (though unlikely) that fossils could be found in the underlying gypsum rock during operation of the Project.

Based on the early results of the archaeological impact assessment (AIA) conducted for the Project, the Project site generally has a generally low potential for harbouring archaeological resources, with the exception of WC2 and a small section of WC1. A site walkover and associated shovel testing (as required) of the Project site will confirm the low archaeological potential. The palaeontological report is currently in preparation and will be provided in a supplemental report, when available.

7.4.6.1 Mitigation and Response

Key mitigation measures to minimize the potential for the discovery of a heritage resource include conducting an archaeological impact assessment (AIA), consisting of background research, map and model interpretation, a walkover of the Project site, and associated shovel test pitting of areas that are determined through the walkover to have a moderate to high archaeological potential. If archaeological or heritage resources are discovered through the AIA, further mitigation including archaeological monitoring during construction and operation, excavation, or other measures would be considered. Additionally, a Project-specific Environmental Protection Plan (EPP) with defined contingency and emergency response procedures in the event of the accidental discovery of a heritage resource will be developed and implemented. The EPP will include contingency and emergency response procedures to be implemented in the event of a chance find of a heritage resource.

In the unlikely event that an archaeological, palaeontological, or cultural resource or artifact is discovered during the construction or operation phases of the Project, the following procedure will be followed, to be updated as part of the development of the EPP:

- Work will be immediately stopped, and the area will be marked to prevent further disturbance. An exclusion zone of 100 m surrounding the find will be established.
- The Site Manager will immediately contact the Archaeology and Heritage Branch of the New Brunswick Department of Tourism, Heritage and Culture to notify them of the discovery and establish a mitigation plan. For fossils, the New Brunswick Museum will be contacted.
- No additional work will be permitted at the site until approval has been received from the appropriate regulatory agency to resume the work.
- If bones or human remains are found, work in the area must cease, and the RCMP shall be immediately notified.
- No one shall disturb, move or rebury uncovered human remains.
- If the discovered resources are related to Indigenous culture, the New Brunswick Department of Aboriginal Affairs will be contacted to determine how best to proceed with respect to repatriation of the resources.

7.4.6.2 Potential Residual Environmental Effects

Given the generally low archaeological potential of the Project site, the potential to encounter previously undiscovered heritage resource during construction and operation of the Project is believed to be low. With the implementation of mitigation measures, contingency and emergency response procedures, and best practices, the potential residual environmental effects of a discovery of a heritage resource on heritage resources during each phase of the Project are not significant, with a moderate level of confidence. The conduct of an AIA including walkover and shovel testing (as required) will improve the level of confidence of this prediction.

7.5 Summary

The potential occurrence of accidents, malfunctions, or unplanned events has been considered as part of the Project design. The potential for accidents, malfunctions, or unplanned events to occur will be carefully considered during planning for the Project, and measures will be developed and implemented such that their potential is reduced. Safeguards will be implemented throughout the construction, operation and reclamation and closure phases. Contingency and emergency response plans will be developed before work is initiated on the proposed Project so that incidents can be managed effectively.

Hammond River Holdings will also develop an Environmental Protection Plan for the management and prevention of such accidents, as well as develop effective response mechanisms for accidents, malfunctions, or unplanned events.

Given the nature of the Project and the credible accident and malfunction scenarios, their low likelihood of occurrence, and proposed mitigation and response planning, the potential residual environmental effects of identified Project-related accidents, malfunctions, and unplanned events on the atmospheric environment, water resources, fish and fish habitat, vegetation and wetlands, wildlife and wildlife habitat, socioeconomic environment, heritage resources, and traditional land and resource use during each phase of the Project are rated not significant, with a high degree of confidence.

8.0 Indigenous Engagement

The entire province of New Brunswick is subject to the Peace and Friendship Treaties signed by the British with the Mi'kmaq, Wolastoqey (Maliseet), and Peskotomuhkati (Passamaquoddy) Nations in 1752 and renewed in specific agreements thereafter. Section 35 of the *Constitution Act, 1982* recognizes and affirms the existing Aboriginal rights and title of the Indigenous peoples of Canada, and the Supreme Court of Canada has affirmed that Mi'kmaq and Wolastoqey communities have treaty rights to carry out traditional activities (including the right to hunt, trap, fish, and gather towards earning a moderate livelihood). The Supreme Court of Canada has also held that the Crown (including the Governments of Canada and New Brunswick) has a duty to consult with Indigenous people, and accommodate them as necessary, for any power, duty or function they may exercise that may affect Aboriginal or treaty rights. Indigenous people also assert Aboriginal rights and title throughout their traditional territory, including on privately-owned land.

Thus, the Province of New Brunswick has a legal duty to consult, and where appropriate accommodate, with Indigenous people when it makes a decision that may affect Aboriginal or treaty rights. Several aspects of the duty to consult that can be delegated to the proponent by the Crown include:

- Notification of a project, and information exchange;
- Assessment of the potential adverse effects from the Project;
- Responding to concerns raised by First Nation communities; and,
- Revisiting project plans to avoid or minimize negative effects posed by the Project.

The planned approach to the delegated aspects of the duty to consult in respect of the EIA of the Project is described in this section.

8.1 Overall Approach

The proposed Project is located within the Peace and Friendship Treaty (INAC n.d.) boundaries, for which both the Mi'kmaq Nation and the Wolastoqey Nation are signatories. As such, Hammond River Holdings will initiate and seek to pursue engagement with all sixteen Indigenous communities in New Brunswick.

To effectively consult with Indigenous communities regarding the Project, engagement will be conducted as described below.

<u>Direct Written Communication</u>

Each Indigenous community and/or organization was initially introduced to the Project through a written introduction letter that describes the Project. A basic project description; description of the Project location and map; and status of the provincial regulatory approval process. In the introduction letter, Hammond River Holdings extended an invitation for face-to-face meetings, via telephone or further written communications to each community to be arranged at their convenience.

For Indigenous communities and organizations interested in more meaningful engagement, Hammond River Holdings has offered to share draft documents, studies, supporting information, with Indigenous communities prior to the document submission to the Crown.

Questions, concerns, and comments from the Indigenous community will be recorded and responded to (as appropriate) in a timely manner. Provided comments are received prior to the submission of the EIA to the Crown, reasonable effort will be made to include comments from Indigenous communities into the final submission.

In Person Meetings

It is understood that each community has a preferred method of engagement that can range from open house style meetings to focused discussions with community representatives (e.g., consultation coordinators or council members). Hammond River Holdings will afford each community the opportunity to determine which style of engagement would best suit their needs. Future meetings and other engagement activities will be defined on a case-by-case basis by each community and/or organization.

Questions, concerns and comments from the Indigenous community will be recorded and responded to (as appropriate) in a timely manner.

Electronic Input

Following submission of the EIA Registration document, an electronic copy of the document will be submitted to each community and/or organization for review and feedback. The EIA Registration document will also be available on the NBDELG website (https://www2.gnb.ca/content/gnb/en/departments/elg/environment/content/environmental_impactassessment/registrations.html) and on the Hammond River Holdings website (www.GlenvaleProject.com). Questions, comments and concerns can be submitted in writing via the Project email address (info@jdirving.com) as well as verbally to the Project Hotline (506-633-3331). Each comment or question will be recorded in a registry, and responses to address the comments will be provided in a timely manner on behalf of Hammond River Holdings.

8.2 Engagement Activities Conducted

The introduction letter (refer to **Appendix F**) was submitted to the following communities and/or organizations in June 2022:

- Amlamgog Nation
- Esgenoonpetitj Nation
- L'nui Menikuk Nation

- Mataqaskiye Nation
- Metapenagiag Nation
- Natoaganeg Nation
- Neqotkuk Nation
- Oinpegitjoig Nation
- Peskotomuhkati Nation
- Pilick Nation
- Sitansisk Nation
- Tjipogtotjg Nation
- Ugpi'ganjig Nation
- Welamukotuk Nation
- Wolastokuk Nation;
- Elsipogtog Nation
- MTI;
- WNNB and;
- New Brunswick Aboriginal Peoples Council

8.3 Key Issues Identification and Management

As part of the Indigenous engagement process, a database will be created where each comment, question, and concern (if any are received) will be recorded along with a summarized response to thoroughly document the engagement process. An example is shown in **Table 8.3.1**.

Table 8.3.1: Sample First Nations Engagement Log

Activity	Individual or Organization	Date	Feedback, Question, Comment or Concern	Summary of Response	Follow Up Action

8.4 Summary Report

In accordance with the EIA Guide (NBDELG 2018a), Hammond River Holdings will record and report on comments received from Indigenous communities in respect of the Project. A summary report documenting the engagement efforts and feedback received during the first 45 days of the comment period following submission of the EIA Registration document will be prepared and submitted to NBDELG for review within 60 days following registration of the Project, so that the information can be considered in the course of decision-making in respect of the Project. It is anticipated that engagement activities will extend beyond this.

The summary report will include: type of engagement activity, individual or organization that was involved and the dates completed; a summary of the feedback received; output from the database as shown in **Table 8.3.1** above; and a summary of planned future engagement activities (if any). Additional mitigative measures or revisions to the Project that may arise throughout the engagement process will be flagged for further consideration by NBDELG.

9.0 Public and Stakeholder Engagement

The planned approach to public and stakeholder engagement in respect of the EIA of the Project is described in this section.

In accordance with the EIA Regulation, direct communication with stakeholders (local residents, elected officials, service groups, businesses, etc.) is required. Evidence of notification will be provided to the NBDELG within 60 days of registration of the Project.

9.1 Objectives and Overall Approach

The following objectives have been established to promote effective communications with the stakeholders and public in respect of the Project:

1. Keep the public informed about the Project through timely and meaningful information updates.
2. Consult with affected stakeholders in a timely manner in an effort to mitigate potential impacts.
3. Provide the public and interested stakeholder groups with opportunities to learn more about the Project, and to share their issues and concerns about the Project.

To effectively inform the public, local residents, key stakeholders, community groups and elected officials of the Project, engagement will be conducted utilizing a three-pronged approach as described below.

“Kitchen Table” Discussions

Representatives from Hammond River Holdings offer to visit each residence within the immediate vicinity of the Project site to introduce the Project through an informal “kitchen table” style meeting. This will provide local residents with an opportunity to gain a better understanding of the Project, from which more detailed future discussions can be based. At this time, it is expected that such discussions would occur immediately prior to, or shortly following, registration of the Project with NBDELG.

Open House

One open house information session on the Project will be conducted in the local community or virtually, to provide additional Project information to interested residents and stakeholders. The open house is anticipated to occur shortly after the submission of the EIA Registration document to the NBDELG. An invitation to the open house, along with a basic project overview, will be placed in the local community newsletter (if available) and the newspaper.

During the meeting, verbal question and comments will be recorded by Project representatives. In addition, forms will be made available to the public where feedback on the project can be submitted in writing, and an email address will be provided where questions and comments can be posed later.

Electronic Input

An electronic copy of the EIA registration document will be made available on the NBDELG EIA webpage, (https://www2.gnb.ca/content/gnb/en/departments/elg/environment/content/environmental_impactassessment/registrations.html) and on the Hammond River Holdings website (www.GlenvaleProject.com). Questions, comments and concerns can be submitted in writing via the Project email address (info@jdirving.com) as well as verbally to the Project hotline (506-633-3331). Each comment or question will be recorded in a registry, and responses to address the comments will be provided in a timely manner on behalf of Hammond River Holdings.

9.2 Engagement Activities Conducted

During the period leading up to registration of the Project, engagement has primarily focused on regulatory agencies and those involved with the Project through the TRC. In addition, nearby residents were notified of a Public Hearing held November 15th regarding the rezoning application filed by Hammond River Holdings for the proposed quarry.

Once registration has been completed, additional engagement of the public and key stakeholders will be initiated in accordance with the approach outlined above.

9.3 Key Issues Identification and Management

As part of the engagement process, a database will be created where each comment, question, and concern, if any are received, will be recorded along with a summarized response, an example of which is shown in **Table 9.3.1**.

Table 9.3.1: Sample Public Consultation Log

Question	Individual or Organization	Date Received	Summary of Response	Follow Up Action

9.4 Summary Report

In accordance with the EIA Guide (NBDELG 2018a), Hammond River Holdings will record and report on comments received from the public in respect of the Project. A summary report documenting the engagement efforts and feedback received during the first 45 days of the comment period following submission of the EIA Registration document will be prepared and submitted to NBDELG for review within 60 days following registration of the Project, so that the information can be considered in the course of decision-making in respect of the Project.

The summary report will include: the dates and types of involvement activities; identification of stakeholders; a summary of the output from the database as shown in **Table 9.3.1** above, if comments/questions are received; and a summary of planned future engagement activities (if any) will be provided to NBDELG following the fulfillment of the public engagement requirements of the EIA process. Additional mitigative measures or revisions to the Project that may arise throughout the public engagement process will be flagged for further consideration by NBDELG.

10.0 Other Information

10.1 Project-Related Documents

This EIA registration document includes other relevant documents as **Appendices A** to **F** of this document, as follows:

- Atlantic Canada Conservation Data Centre Data Report 7252: Glenvale, NB, attached as **Appendix A**.
- Results of the WESP-AC wetland functional assessment, attached as **Appendix B**.
- Field data acquired for plants and vegetation, attached as **Appendix C**.
- Desktop analysis data acquired for migratory birds, attached as **Appendix D**.
- Detailed observations of avian surveys, attached as **Appendix E.**
- Indigenous Engagement, attached as **Appendix F**.

Other than this EIA registration document and the appended information, there are no additional Project-related documents that are publicly accessible.

Following completion of the EIA review for the Project and the receipt of a Certificate of Determination, a number of other authorizations, approvals, permits, licenses, or leases may be required from provincial or federal agencies. Refer to **Sections 1.3.1.2** and **1.3.2.2** of this document for more information.

10.2 Funding

The Project will be funded entirely by Hammond River Holdings Limited and related private companies, and does not involve the receipt of any funds, loans, loan guarantees, land transfers, or other types of financial support from any federal or provincial government department or agency.

11.0 Summary and Conclusion

This environmental impact assessment (EIA) registration document describes the planned development of, and provides an environmental effects assessment for, the Glenvale Gypsum Quarry Project (the "Project") proposed by Hammond River Holdings Limited (Hammond River Holdings) in the community of Glenvale, Westmorland County, New Brunswick. The Project consists of the development of a new open pit quarry for the extraction of gypsum to be used in the production of gypsum wallboard at the Wallboard facility in Saint John, New Brunswick.

This document is being submitted to the New Brunswick Department of Environment and Local Government (NBDELG) as part of the EIA process under the New Brunswick *Environmental Impact Assessment Regulation 87-83* of the *Clean Environment Act*. A federal environmental assessment (EA) under the *Impact Assessment Act* is not believed to be required for the Project.

The Project is intended to supply natural gypsum rock for the production of gypsum wallboard at the Wallboard facility in Saint John, New Brunswick. Natural gypsum, currently supplied from the Upham East Gypsum Quarry, is currently in its third year of an expected 10-year life span. To prevent a disruption in supply, avoid costly alternatives such as importing from elsewhere, and maintain competitiveness in the North American marketplace, an additional economically viable locally-produced resource is necessary.

The Project involves many of the following components, subject to further definition and design:

- an open pit (quarry), and related use of explosives;
- a portable crusher;
- heavy mobile equipment (e.g., front end loader, excavators, bulldozer, dump trucks);
- a storage area for gypsum;
- storage areas for overburden and topsoil;
- facilities for pit dewatering and runoff management;
- a truck scale, security gate, and portable trailer; and,
- an access road from the provincial Route 890 to the site, and internal roads between various components of the Project.

In accordance with the requirements the New Brunswick *Environmental Impact Assessment Regulation– Clean Environment Act*, this EIA Registration provided Project-related information available at the early stage of its conceptual development, and has assessed the environmental effects of the Project. The key elements of this report are as follows:

- A description of the proposed components of the Project, including a discussion of how the Project would be constructed, operated, and ultimately reclaimed and closed at the end of its life as well as consideration of alternative means of carrying out the Project. Project-related emissions and wastes were also described. Project planning and management strategies to minimize the environmental effects of the Project were also introduced.
- A high-level summary of the environmental setting for the Project was provided to introduce general physical, biological, and socioeconomic conditions applicable in the general area of the Project.
- The scope of the EIA, including the scope of the Project, factors to be considered, and scope of those factors were described. The methods that were to be used to conduct the environmental effects assessment of the Project were discussed.
- An assessment of potential environmental effects of the Project on each valued component (VC) of relevance and importance to this EIA was conducted. Nine VCs were identified as relevant and important to the EIA of the Project: atmospheric environment; water resources; fish and fish habitat, vegetation and wetlands, wildlife and wildlife habitat, agricultural land and livestock; socioeconomic environment; heritage resources; and traditional land and resource use. Additionally, effects of the environment on the Project, as well as accidents, malfunctions, and unplanned events, were assessed. Where applicable, follow-up or monitoring measures to verify the environmental effects predictions of this EIA or to verify the effectiveness of mitigation to avoid or minimize environmental effects were identified.
- Planned Indigenous and public engagement activities in respect of the Project were described.

The environmental effects assessment concluded that there would be no significant adverse residual environmental effects from the Project during each phase assessed and in consideration of normal activities of the Project as planned. Positive environmental effects were predicted for the socioeconomic environment as they relate to employment during the operation phase. Effects of the environment on the Project were predicted to be not significant due to the nature of the Project that incorporate factors of safety and other mitigation to minimize the likelihood of a significant adverse effect of the environment on the Project. The potential residual environmental effects of accidents, malfunctions, and unplanned events were also found to be not significant. A limited number of follow-up or monitoring initiatives have been developed to verify the predictions of this EIA Registration or to verify the effectiveness of mitigation.

Overall, based on the results of this EIA Registration, it is concluded that, with planned mitigation and the implementation of best practices to avoid or minimize adverse environmental effects, the residual environmental effects of the Project, including the effects of the environment on the Project and from accidents, malfunctions and unplanned events, during all phases are rated not significant.

12.0 Closing

This document is submitted on behalf of Hammond River Holdings Limited.

Daniel Guest

12/21/2022

Daniel Guest **Date of Signature**

This report was prepared by Dillon Consulting Limited (Dillon) on behalf of Hammond River Holdings Limited. Dillon has used the degree of care and skill ordinarily exercised under similar circumstances at the time the work was performed by reputable members of the environmental consulting profession practicing in Canada. Dillon assumes no responsibility for conditions which were beyond its scope of work. There is no warranty expressed or implied by Dillon.

The material in the report reflects Dillon's best judgment in light of the information available to Dillon at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibilities of such third parties. Dillon accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

This report has been prepared by a team of Dillon professionals on behalf of Hammond River Holdings Limited.

Respectfully submitted,

DILLON CONSULTING LIMITED

Jonathan Oliver, P.Geo., M.Sc.
Project Manager, Associate

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Appendix A

AC CDC Report

Atlantic Canada Conservation Data Centre
Centre de données sur la conservation du Canada atlantique

DATA REPORT 7252: Glenvale, NB

Prepared 27 April 2022
by J. Churchill, Data Manager

CONTENTS OF REPORT

Map 1. A 100 km buffer around the study area

1.0 PREFACE

The Atlantic Canada Conservation Data Centre (AC CDC; www.accdc.com) is part of a network of NatureServe data centres and heritage programs serving 50 states in the U.S.A, 10 provinces and 1 territory in Canada, plus several Central and South American countries. The NatureServe network is more than 30 years old and shares a common conservation data methodology. The AC CDC was founded in 1997, and maintains data for the jurisdictions of New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador. Although a non-governmental agency, the AC CDC is supported by 6 federal agencies and 4 provincial governments, as well as through outside grants and data processing fees.

Upon request and for a fee, the AC CDC queries its database and produces customized reports of the rare and endangered flora and fauna known to occur in or near a specified study area. As a supplement to that data, the AC CDC includes locations of managed areas with some level of protection, and known sites of ecological interest or sensitivity.

1.1 DATA LIST

Included datasets:

Filename	**Contents**
GlenvaleNB_7252ob.xls	Rare or legally-protected Flora and Fauna in your study area
GlenvaleNB_7252ob100km.xls	A list of Rare and legally protected Flora and Fauna within 100 km of your study area
GlenvaleNB_7252msa.xls	Managed and Biologically Significant Areas in your study area
GlenvaleNB_7252ff_py.xls	Rare Freshwater Fish in your study area (DFO database)

1.2 RESTRICTIONS

The AC CDC makes a strong effort to verify the accuracy of all the data that it manages, but it shall not be held responsible for any inaccuracies in data that it provides. By accepting AC CDC data, recipients assent to the following limits of use:

a) Data is restricted to use by trained personnel who are sensitive to landowner interests and to potential threats to rare and/or endangered flora and fauna posed by the information provided.
b) Data is restricted to use by the specified Data User; any third party requiring data must make its own data request.
c) The AC CDC requires Data Users to cease using and delete data 12 months after receipt, and to make a new request for updated data if necessary at that time.
d) AC CDC data responses are restricted to the data in our Data System at the time of the data request.
e) Each record has an estimate of locational uncertainty, which must be referenced in order to understand the record's relevance to a particular location. Please see attached Data Dictionary for details.
f) AC CDC data responses are not to be construed as exhaustive inventories of taxa in an area.
g) The absence of a taxon cannot be inferred by its absence in an AC CDC data response.

1.3 ADDITIONAL INFORMATION

The accompanying Data Dictionary provides metadata for the data provided.

Please direct any additional questions about AC CDC data to the following individuals:

Plants, Lichens, Ranking Methods, All other Inquiries
Sean Blaney
Senior Scientist / Executive Director
(506) 364-2658
sean.blaney@accdc.ca

Animals (Fauna)
John Klymko
Zoologist
(506) 364-2660
john.klymko@accdc.ca

Data Management, GIS
James Churchill
Conservation Data Analyst / Field Biologist
(902) 679-6146
james.churchill@accdc.ca

Billing
Jean Breau
Financial Manager / Executive Assistant
(506) 364-2657
jean.breau@accdc.ca

Questions on the biology of Federal Species at Risk can be directed to AC CDC: (506) 364-2658, with questions on Species at Risk regulations to: Samara Eaton, Canadian Wildlife Service (NB and PE): (506) 364-5060 or Julie McKnight, Canadian Wildlife Service (NS): (902) 426-4196.

For provincial information about rare taxa and protected areas, or information about game animals, deer yards, old growth forests, archeological sites, fish habitat etc., in New Brunswick, please contact Hubert Askanas, Energy and Resource Development: (506) 453-5873.

For provincial information about rare taxa and protected areas, or information about game animals, deer yards, old growth forests, archeological sites, fish habitat etc., in Nova Scotia, please contact Donna Hurlburt, NS DLF: (902) 679-6886. To determine if location-sensitive species (section 4.3) occur near your study site please contact a NS DLF Regional Biologist:

Western: Emma Vost
(902) 670-8187
Emma.Vost@novascotia.ca

Western: Sarah Spencer
(902) 541-0081
Sarah.Spencer@novascotia.ca

Central: Shavonne Meyer
(902) 893-0816
Shavonne.Meyer@novascotia.ca

Central: Kimberly George
(902) 890-1046
Kimberly.George@novascotia.ca

Eastern: Harrison Moore
(902) 497-4119
Harrison.Moore@novascotia.ca

Eastern: Maureen Cameron-MacMillan
(902) 295-2554
Maureen.Cameron-MacMillan@novascotia.ca

Eastern: Elizabeth Walsh
(902) 563-3370
Elizabeth.Walsh@novascotia.ca

For provincial information about rare taxa and protected areas, or information about game animals, fish habitat etc., in Prince Edward Island, please contact Garry Gregory, PEI Dept. of Communities, Land and Environment: (902) 569-7595.

2.0 RARE AND ENDANGERED SPECIES

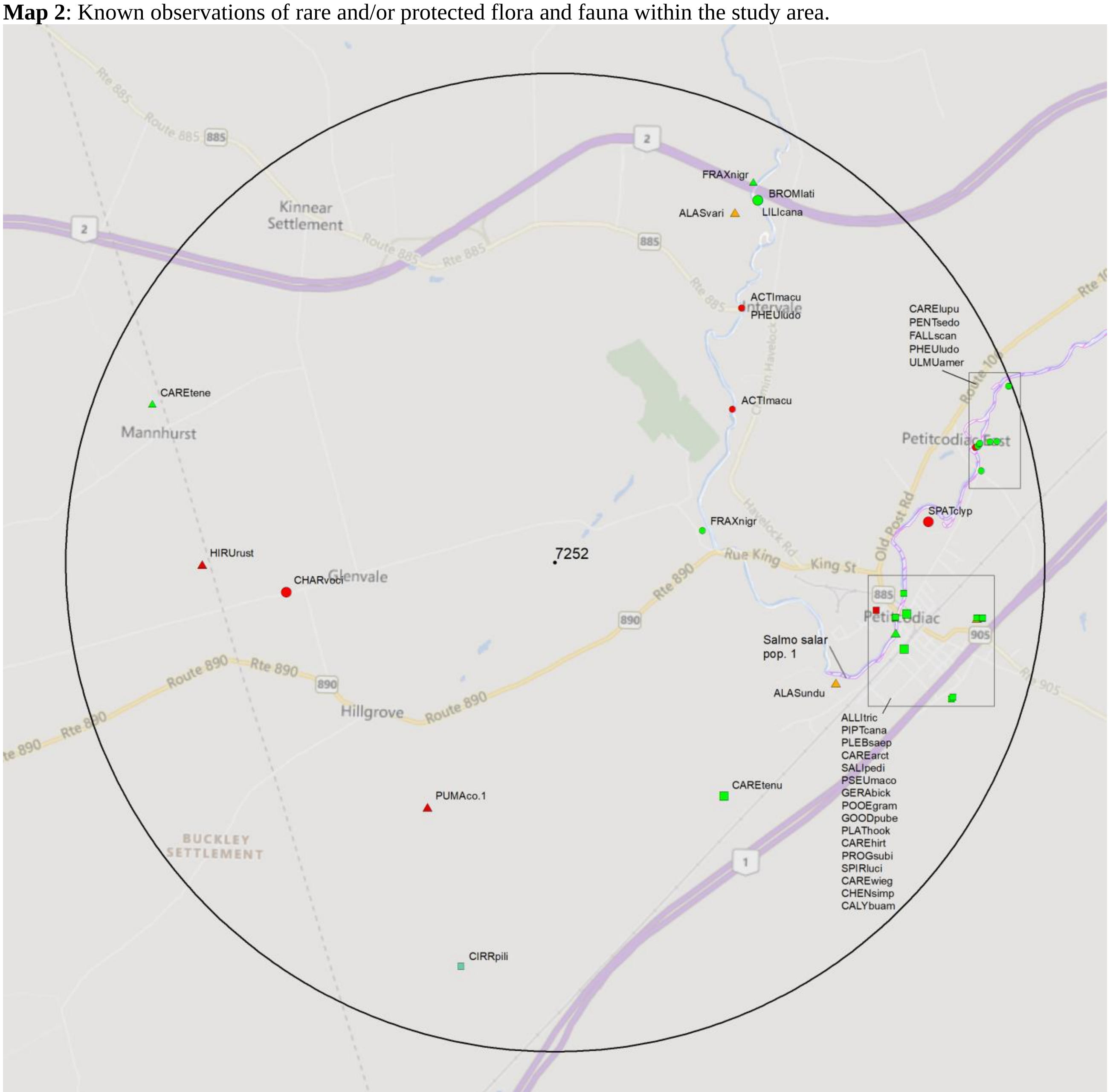
2.1 FLORA

The study area contains 30 records of 22 vascular, 1 record of 1 nonvascular flora (Map 2 and attached: *ob.xls).

2.2 FAUNA

The study area contains 13 records of 8 vertebrate, 3 records of 3 invertebrate fauna (Map 2 and attached data files - see 1.1 Data List). Please see section 4.3 to determine if 'location-sensitive' species occur near your study site.

Map 2: Known observations of rare and/or protected flora and fauna within the study area.



RESOLUTION

- 4.7 within 50s of kilometers
- 4.0 within 10s of kilometers
- 3.7 within 5s of kilometers
- 3.0 within kilometers
- 2.7 within 500s of meters
- 2.0 within 100s of meters
- 1.7 within 10s of meters

HIGHER TAXON

- vertebrate fauna
- invertebrate fauna
- vascular flora
- nonvascular flora

3.0 SPECIAL AREAS

3.1 MANAGED AREAS
The GIS scan identified no managed areas in the vicinity of the study area (Map 3).

3.2 SIGNIFICANT AREAS
The GIS scan identified 2 biologically significant sites in the vicinity of the study area (Map 3 and attached file: *msa.xls).

Map 3: Boundaries and/or locations of known Managed and Significant Areas within the study area.

4.0 RARE SPECIES LISTS

Rare and/or endangered taxa (excluding "location-sensitive" species, section 4.3) within the study area listed in order of concern, beginning with legally listed taxa, with the number of observations per taxon and the distance in kilometers from study area centroid to the closest observation (± the precision, in km, of the record). [P] = vascular plant, [N] = nonvascular plant, [A] = vertebrate animal, [I] = invertebrate animal, [C] = community. Note: records are from attached files *ob.xls/*ob.shp only.

4.1 FLORA

	Scientific *Name*	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)
N	*Cirriphyllum piliferum*	Hair-pointed Moss				S2	1	4.2 ± 5.0
P	*Fraxinus nigra*	Black Ash	Threatened			S3S4	2	1.5 ± 0.0
P	*Chenopodiastrum simplex*	Maple-leaved Goosefoot				S1	2	4.3 ± 5.0
P	*Goodyera pubescens*	Downy Rattlesnake-Plantain				S1	3	4.4 ± 5.0
P	*Calypso bulbosa var. americana*	Calypso				S2	1	4.3 ± 5.0
P	*Allium tricoccum*	Wild Leek				S2S3	1	3.6 ± 5.0
P	*Piptatheropsis canadensis*	Canada Ricegrass				S2S3	1	3.6 ± 10.0
P	*Pseudognaphalium macounii*	Macoun's Cudweed				S3	1	4.4 ± 5.0
P	*Geranium bicknellii*	Bicknell's Crane's-bill				S3	1	4.4 ± 5.0
P	*Carex arcta*	Northern Clustered Sedge				S3	1	3.5 ± 5.0
P	*Carex hirtifolia*	Pubescent Sedge				S3	1	3.5 ± 5.0
P	*Carex tenuiflora*	Sparse-Flowered Sedge				S3	1	2.9 ± 10.0
P	*Spiranthes lucida*	Shining Ladies'-Tresses				S3	1	3.6 ± 1.0
P	*Bromus latiglumis*	Broad-Glumed Brome				S3	1	4.2 ± 0.0
P	*Platanthera hookeri*	Hooker's Orchid				S3?	1	4.3 ± 2.0
P	*Penthorum sedoides*	Ditch Stonecrop				S3S4	2	4.5 ± 0.0
P	*Fallopia scandens*	Climbing False Buckwheat				S3S4	4	4.5 ± 0.0
P	*Salix pedicellaris*	Bog Willow				S3S4	1	4.4 ± 5.0
P	*Ulmus americana*	White Elm				S3S4	1	4.4 ± 0.0
P	*Carex lupulina*	Hop Sedge				S3S4	1	5.0 ± 0.0
P	*Carex tenera*	Tender Sedge				S3S4	1	4.4 ± 0.0
P	*Carex wiegandii*	Wiegand's Sedge				S3S4	1	3.7 ± 10.0
P	*Lilium canadense*	Canada Lily				S3S4	1	4.2 ± 0.0

4.2 FAUNA

	Scientific *Name*	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)
A	*Hirundo rustica*	Barn Swallow	Special Concern	Threatened	Threatened	S2B	1	3.6 ± 3.0
A	*Puma concolor pop. 1*	Cougar - Eastern population	Data Deficient		Endangered	SU	1	2.8 ± 1.0
A	*Progne subis*	Purple Martin				S1B	4	3.3 ± 7.0
A	*Pooecetes gramineus*	Vesper Sparrow				S2B	1	3.3 ± 7.0
A	*Spatula clypeata*	Northern Shoveler				S3B	1	3.8 ± 0.0
A	*Charadrius vociferus*	Killdeer				S3B	1	2.8 ± 0.0
A	*Pheucticus ludovicianus*	Rose-breasted Grosbeak				S3B	2	3.2 ± 0.0
A	*Actitis macularius*	Spotted Sandpiper				S3S4B,S4M	2	2.4 ± 0.0
I	*Alasmidonta varicosa*	Brook Floater	Special Concern	Special Concern	Special Concern	S3	1	4.0 ± 1.0
I	*Icaricia saepiolus*	Greenish Blue				S1S2	1	4.3 ± 2.0
I	*Alasmidonta undulata*	Triangle Floater				S3	1	3.1 ± 1.0

4.3 LOCATION SENSITIVE SPECIES

The Department of Natural Resources in each Maritimes province considers a number of species “location sensitive”. Concern about exploitation of location-sensitive species precludes inclusion of precise coordinates in this report. Those intersecting your study area are indicated below with “YES”.

New Brunswick

Scientific *Name*	Common Name	SARA	Prov Legal Prot	Known within the Study Site?
Chrysemys picta picta	Eastern Painted Turtle	Special Concern		No
Chelydra serpentina	Snapping Turtle	Special Concern	Special Concern	No
Glyptemys insculpta	**Wood Turtle**	**Threatened**	**Threatened**	**YES**
Haliaeetus leucocephalus	**Bald Eagle**		**Endangered**	**YES**
Falco peregrinus pop. 1	Peregrine Falcon - anatum/tundrius pop.	Special Concern	Endangered	No
Cicindela marginipennis	Cobblestone Tiger Beetle	Endangered	Endangered	No
Coenonympha nipisiquit	Maritime Ringlet	Endangered	Endangered	No
Bat hibernaculum or bat species occurrence		[Endangered][1]	[Endangered][1]	No

1 *Myotis lucifugus* (Little Brown Myotis), *Myotis septentrionalis* (Long-eared Myotis), and *Perimyotis subflavus* (Tri-colored Bat or Eastern Pipistrelle) are all Endangered under the Federal Species at Risk Act and the NB Species at Risk Act.

4.4 SOURCE BIBLIOGRAPHY

The recipient of these data shall acknowledge the AC CDC and the data sources listed below in any documents, reports, publications or presentations, in which this dataset makes a significant contribution.

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5.0 RARE SPECIES WITHIN 100 KM

A 100 km buffer around the study area contains 59581 records of 156 vertebrate and 1556 records of 85 invertebrate fauna; 9307 records of 309 vascular, 1943 records of 208 nonvascular flora (attached: *ob100km.xls).

Taxa within 100 km of the study site that are rare and/or endangered in the province in which the study site occurs (including "location-sensitive" species). All ranks correspond to the province in which the study site falls, even for out-of-province records. Taxa are listed in order of concern, beginning with legally listed taxa, with the number of observations per taxon and the distance in kilometers from study area centroid to the closest observation (± the precision, in km, of the record).

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
A	*Myotis lucifugus*	Little Brown Myotis	Endangered	Endangered	Endangered	S1	62	28.7 ± 0.0	NB
A	*Myotis septentrionalis*	Northern Myotis	Endangered	Endangered	Endangered	S1	17	28.7 ± 0.0	NB
A	*Perimyotis subflavus*	Tricolored Bat	Endangered	Endangered	Endangered	S1	17	26.5 ± 1.0	NB
A	*Charadrius melodus melodus*	Piping Plover melodus subspecies	Endangered	Endangered	Endangered	S1B	669	44.0 ± 7.0	NB
A	*Sterna dougallii*	Roseate Tern	Endangered	Endangered	Endangered	S1B	1	85.0 ± 0.0	NS
A	*Dermochelys coriacea pop. 2*	Leatherback Sea Turtle - Atlantic population	Endangered	Endangered	Endangered	S1S2N	3	86.7 ± 1.0	NB
A	*Salmo salar pop. 1*	Atlantic Salmon - Inner Bay of Fundy population	Endangered	Endangered	Endangered	S2	646	10.6 ± 0.0	NB
A	*Salmo salar pop. 7*	Atlantic Salmon - Outer Bay of Fundy population	Endangered		Endangered	SNR	405	10.5 ± 0.0	NB
A	*Rangifer tarandus pop. 2*	Caribou - Atlantic-Gasp├┐sie population	Endangered	Endangered	Extirpated	SX	4	36.8 ± 1.0	NB
A	*Lanius ludovicianus*	Loggerhead Shrike	Endangered	Endangered		SXB	1	38.1 ± 0.0	NB
A	*Sturnella magna*	Eastern Meadowlark	Threatened	Threatened	Threatened	S1B	53	10.0 ± 7.0	NB
A	*Asio flammeus*	Short-eared Owl	Threatened	Special Concern	Special Concern	S1S2B	55	42.8 ± 64.0	NB
A	*Ixobrychus exilis*	Least Bittern	Threatened	Threatened	Threatened	S1S2B	27	31.4 ± 7.0	NB
A	*Hylocichla mustelina*	Wood Thrush	Threatened	Threatened	Threatened	S1S2B	134	5.2 ± 7.0	NB
A	*Hydrobates leucorhous*	Leach's Storm-Petrel	Threatened			S1S2B	1	72.4 ± 0.0	NB
A	*Antrostomus vociferus*	Eastern Whip-Poor-Will	Threatened	Threatened	Threatened	S2B	54	23.6 ± 0.0	NB
A	*Catharus bicknelli*	Bicknell's Thrush	Threatened	Threatened	Threatened	S2B	9	41.5 ± 11.0	NB
A	*Riparia riparia*	Bank Swallow	Threatened	Threatened		S2B	1236	6.1 ± 7.0	NB
A	*Glyptemys insculpta*	Wood Turtle	Threatened	Threatened	Threatened	S2S3	1354	3.7 ± 0.0	NB
A	*Chaetura pelagica*	Chimney Swift	Threatened	Threatened	Threatened	S2S3B,S2M	308	14.5 ± 0.0	NB
A	*Dolichonyx oryzivorus*	Bobolink	Threatened	Threatened	Threatened	S3B	2052	5.2 ± 7.0	NB
A	*Acipenser oxyrinchus*	Atlantic Sturgeon	Threatened		Threatened	S3B,S3N	4	18.4 ± 1.0	NB
A	*Tringa flavipes*	Lesser Yellowlegs	Threatened			S3M	1326	16.6 ± 0.0	NB
A	*Limosa haemastica*	Hudsonian Godwit	Threatened			S3M	185	47.2 ± 0.0	NB
A	*Anguilla rostrata*	American Eel	Threatened		Threatened	S4N	7033	11.0 ± 0.0	NB
A	*Coturnicops noveboracensis*	Yellow Rail	Special Concern	Special Concern	Special Concern	S1?B,SUM	8	51.8 ± 3.0	NB
A	*Histrionicus histrionicus pop. 1*	Harlequin Duck - Eastern population	Special Concern	Special Concern	Endangered	S1B,S1S2N,S2M	7	43.2 ± 0.0	NB
A	*Hirundo rustica*	Barn Swallow	Special Concern	Threatened	Threatened	S2B	1650	3.6 ± 3.0	NB
A	*Salmo salar pop. 12*	Atlantic Salmon - Gaspe - Southern Gulf of St. Lawrence population	Special Concern		Special Concern	S2S3	6	50.6 ± 50.0	NB
A	*Balaenoptera physalus*	Fin Whale	Special Concern	Special Concern		S2S3	2	48.4 ± 1.0	NB
A	*Euphagus carolinus*	Rusty Blackbird	Special Concern	Special Concern	Special Concern	S2S3B,S3M	134	9.1 ± 7.0	NB
A	*Bucephala islandica*	Barrow's Goldeneye	Special Concern	Special Concern	Special Concern	S2S3N,S3M	128	19.2 ± 83.0	NB
A	*Acipenser brevirostrum*	Shortnose Sturgeon	Special Concern	Special Concern	Special Concern	S3	9	61.9 ± 10.0	NB
A	*Chelydra serpentina*	Snapping Turtle	Special Concern	Special Concern	Special Concern	S3	30	51.2 ± 1.0	NB
A	*Contopus virens*	Eastern Wood-Pewee	Special Concern	Special Concern	Special Concern	S3B	923	8.7 ± 0.0	NB
A	*Contopus cooperi*	Olive-sided Flycatcher	Special Concern	Threatened	Threatened	S3B	659	8.6 ± 7.0	NB
A	*Coccothraustes vespertinus*	Evening Grosbeak	Special Concern	Special Concern		S3B,S3S4N,SUM	368	5.2 ± 7.0	NB
A	*Chordeiles minor*	Common Nighthawk	Special Concern	Threatened	Threatened	S3B,S4M	407	5.2 ± 0.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
A	*Phalaropus lobatus*	Red-necked Phalarope	Special Concern	Special Concern		S3M	18	19.3 ± 0.0	NB
A	*Podiceps auritus*	Horned Grebe	Special Concern	Special Concern	Special Concern	S3N	50	25.3 ± 219.0	NB
A	*Cardellina canadensis*	Canada Warbler	Special Concern	Threatened	Threatened	S3S4B	991	5.3 ± 7.0	NB
A	*Phocoena phocoena*	Harbour Porpoise	Special Concern		Spec.Concern	S4	8	46.4 ± 0.0	NB
A	*Chrysemys picta picta*	Eastern Painted Turtle	Special Concern	Special Concern		S4	46	57.6 ± 1.0	NB
A	*Hemidactylium scutatum*	Four-toed Salamander	Not At Risk			S1?	4	41.7 ± 0.0	NB
A	*Fulica americana*	American Coot	Not At Risk			S1B	69	16.7 ± 2.0	NB
A	*Falco peregrinus pop. 1*	Peregrine Falcon - anatum/tundrius	Not At Risk	Special Concern	Endangered	S1B,S3M	449	19.2 ± 0.0	NB
A	*Falco peregrinus*	Peregrine Falcon	Not At Risk	Special Concern		S1B,S3M	1	97.4 ± 0.0	NB
A	*Bubo scandiacus*	Snowy Owl	Not At Risk			S1N,S2S3M	43	18.4 ± 1.0	NB
A	*Accipiter cooperii*	Cooper's Hawk	Not At Risk			S1S2B	17	17.9 ± 7.0	NB
A	*Buteo lineatus*	Red-shouldered Hawk	Not At Risk			S1S2B	41	9.1 ± 7.0	NB
A	*Aegolius funereus*	Boreal Owl	Not At Risk			S1S2B,SUM	5	72.0 ± 0.0	NB
A	*Sorex dispar*	Long-tailed Shrew	Not At Risk			S2	5	37.1 ± 0.0	NB
A	*Chlidonias niger*	Black Tern	Not At Risk			S2B	509	19.3 ± 0.0	NB
A	*Podiceps grisegena*	Red-necked Grebe	Not At Risk			S2N,S3M	47	50.9 ± 5.0	NB
A	*Globicephala melas*	Long-finned Pilot Whale	Not At Risk			S2S3	2	81.6 ± 0.0	NB
A	*Desmognathus fuscus pop. 2*	Northern Dusky Salamander - Quebec / New Brunswick population	Not At Risk			S3	37	42.8 ± 0.0	NB
A	*Megaptera novaeangliae*	Humpback Whale	Not At Risk			S3	2	93.1 ± 1.0	NS
A	*Sterna hirundo*	Common Tern	Not At Risk			S3B,SUM	553	37.0 ± 2.0	NB
A	*Lagenorhynchus acutus*	Atlantic White-sided Dolphin	Not At Risk			S3S4	2	53.1 ± 1.0	NB
A	*Haliaeetus leucocephalus*	Bald Eagle	Not At Risk		Endangered	S4	1468	1.6 ± 0.0	NB
A	*Lynx canadensis*	Canada Lynx	Not At Risk		Endangered	S4	19	20.3 ± 10.0	NB
A	*Canis lupus*	Grey Wolf	Not At Risk		Extirpated	SX	3	32.7 ± 1.0	NB
A	*Puma concolor pop. 1*	Cougar - Eastern population	Data Deficient		Endangered	SU	125	2.8 ± 1.0	NB
A	*Calidris canutus rufa*	Red Knot rufa subspecies - Tierra del Fuego / Patagonia wintering population	E,SC	Endangered	Endangered	S2M	494	37.7 ± 0.0	NB
A	*Morone saxatilis*	Striped Bass	E,SC			S3S4B,S3S4N	8640	18.4 ± 0.0	NB
A	*Salmo salar*	Atlantic Salmon	E,T,SC			S2S3	1	91.1 ± 0.0	NB
A	*Thryothorus ludovicianus*	Carolina Wren				S1	10	37.6 ± 0.0	NB
A	*Salvelinus alpinus*	Arctic Char				S1	3	36.4 ± 1.0	NB
A	*Vireo flavifrons*	Yellow-throated Vireo				S1?B	4	31.4 ± 7.0	NB
A	*Tringa melanoleuca*	Greater Yellowlegs				S1?B,S4S5M	1979	10.6 ± 0.0	NB
A	*Aythya americana*	Redhead				S1B	11	42.8 ± 0.0	NB
A	*Gallinula galeata*	Common Gallinule				S1B	54	16.6 ± 0.0	NB
A	*Grus canadensis*	Sandhill Crane				S1B	26	31.0 ± 0.0	NB
A	*Bartramia longicauda*	Upland Sandpiper				S1B	56	17.1 ± 2.0	NB
A	*Phalaropus tricolor*	Wilson's Phalarope				S1B	48	19.0 ± 0.0	NB
A	*Leucophaeus atricilla*	Laughing Gull				S1B	11	38.9 ± 1.0	NB
A	*Rissa tridactyla*	Black-legged Kittiwake				S1B	4	70.3 ± 0.0	NB
A	*Fratercula arctica*	Atlantic Puffin				S1B	2	41.5 ± 11.0	NB
A	*Progne subis*	Purple Martin				S1B	239	3.3 ± 7.0	NB
A	*Aythya marila*	Greater Scaup				S1B,S2N,S4M	33	43.7 ± 1.0	NB
A	*Oxyura jamaicensis*	Ruddy Duck				S1B,S2S3M	112	16.6 ± 0.0	NB
A	*Aythya affinis*	Lesser Scaup				S1B,S4M	224	19.3 ± 0.0	NB
A	*Eremophila alpestris*	Horned Lark				S1B,S4N,S5M	59	5.2 ± 7.0	NB
A	*Sterna paradisaea*	Arctic Tern				S1B,SUM	13	41.5 ± 11.0	NB
A	*Chroicocephalus ridibundus*	Black-headed Gull				S1N,S2M	13	38.3 ± 0.0	NB
A	*Branta bernicla*	Brant				S1N,S2S3M	37	37.7 ± 0.0	NB
A	*Calidris alba*	Sanderling				S1N,S3S4M	1343	26.7 ± 0.0	NB
A	*Butorides virescens*	Green Heron				S1S2B	19	29.6 ± 7.0	NB
A	*Nycticorax nycticorax*	Black-crowned Night-heron				S1S2B	9	38.1 ± 0.0	NB
A	*Empidonax traillii*	Willow Flycatcher				S1S2B	99	5.3 ± 7.0	NB
A	*Stelgidopteryx serripennis*	Northern Rough-winged				S1S2B	5	42.0 ± 0.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
		Swallow							
A	*Troglodytes aedon*	House Wren				S1S2B	21	40.4 ± 7.0	NB
A	*Calidris bairdii*	Baird's Sandpiper				S1S2M	58	41.1 ± 0.0	NB
A	*Melanitta americana*	American Scoter				S1S2N,S3M	239	19.1 ± 1.0	NB
A	*Petrochelidon pyrrhonota*	Cliff Swallow				S2B	693	5.2 ± 7.0	NB
A	*Cistothorus palustris*	Marsh Wren				S2B	243	31.4 ± 7.0	NB
A	*Mimus polyglottos*	Northern Mockingbird				S2B	152	17.1 ± 7.0	NB
A	*Pooecetes gramineus*	Vesper Sparrow				S2B	123	3.3 ± 7.0	NB
A	*Mareca strepera*	Gadwall				S2B,S3M	329	16.7 ± 0.0	NB
A	*Tringa solitaria*	Solitary Sandpiper				S2B,S4S5M	169	10.7 ± 0.0	NB
A	*Pinicola enucleator*	Pine Grosbeak				S2B,S4S5N,S4S5M	39	21.3 ± 0.0	NB
A	*Phalacrocorax carbo*	Great Cormorant				S2N	29	37.2 ± 2.0	NB
A	*Somateria spectabilis*	King Eider				S2N	4	63.8 ± 0.0	NB
A	*Larus hyperboreus*	Glaucous Gull				S2N	133	30.1 ± 0.0	NB
A	*Melanitta perspicillata*	Surf Scoter				S2N,S4M	14	57.5 ± 0.0	NB
A	*Melanitta deglandi*	White-winged Scoter				S2N,S4M	3	44.8 ± 0.0	NB
A	*Asio otus*	Long-eared Owl				S2S3	23	17.9 ± 7.0	NB
A	*Picoides dorsalis*	American Three-toed Woodpecker				S2S3	15	16.6 ± 0.0	NB
A	*Toxostoma rufum*	Brown Thrasher				S2S3B	33	19.3 ± 7.0	NB
A	*Icterus galbula*	Baltimore Oriole				S2S3B	217	5.3 ± 7.0	NB
A	*Somateria mollissima*	Common Eider				S2S3B,S2S3N,S4M	222	41.5 ± 11.0	NB
A	*Larus delawarensis*	Ring-billed Gull				S2S3B,S4N,S5M	433	19.2 ± 1.0	NB
A	*Pluvialis dominica*	American Golden-Plover				S2S3M	183	47.2 ± 0.0	NB
A	*Calcarius lapponicus*	Lapland Longspur				S2S3N,SUM	43	31.1 ± 9.0	NB
A	*Larus marinus*	Great Black-backed Gull				S3	323	31.9 ± 0.0	NB
A	*Picoides arcticus*	Black-backed Woodpecker				S3	86	12.1 ± 0.0	NB
A	*Loxia curvirostra*	Red Crossbill				S3	190	11.7 ± 0.0	NB
A	*Spinus pinus*	Pine Siskin				S3	485	5.2 ± 7.0	NB
A	*Prosopium cylindraceum*	Round Whitefish				S3	1	82.3 ± 0.0	NB
A	*Salvelinus namaycush*	Lake Trout				S3	1	35.5 ± 0.0	NB
A	*Sorex maritimensis*	Maritime Shrew				S3	118	71.6 ± 1.0	NB
A	*Spatula clypeata*	Northern Shoveler				S3B	519	3.8 ± 0.0	NB
A	*Charadrius vociferus*	Killdeer				S3B	968	2.8 ± 0.0	NB
A	*Tringa semipalmata*	Willet				S3B	701	16.6 ± 0.0	NB
A	*Cepphus grylle*	Black Guillemot				S3B	59	41.5 ± 11.0	NB
A	*Coccyzus erythropthalmus*	Black-billed Cuckoo				S3B	198	10.0 ± 1.0	NB
A	*Myiarchus crinitus*	Great Crested Flycatcher				S3B	299	19.3 ± 7.0	NB
A	*Piranga olivacea*	Scarlet Tanager				S3B	88	5.2 ± 7.0	NB
A	*Pheucticus ludovicianus*	Rose-breasted Grosbeak				S3B	902	3.2 ± 0.0	NB
A	*Passerina cyanea*	Indigo Bunting				S3B	94	30.3 ± 0.0	NB
A	*Molothrus ater*	Brown-headed Cowbird				S3B	345	5.2 ± 7.0	NB
A	*Setophaga tigrina*	Cape May Warbler				S3B,S4S5M	306	13.5 ± 7.0	NB
A	*Mergus serrator*	Red-breasted Merganser				S3B,S4S5N,S5M	243	22.5 ± 7.0	NB
A	*Anas acuta*	Northern Pintail				S3B,S5M	156	31.4 ± 7.0	NB
A	*Anser caerulescens*	Snow Goose				S3M	25	16.6 ± 0.0	NB
A	*Numenius phaeopus hudsonicus*	Whimbrel				S3M	171	37.7 ± 0.0	NB
A	*Arenaria interpres*	Ruddy Turnstone				S3M	617	37.7 ± 0.0	NB
A	*Calidris pusilla*	Semipalmated Sandpiper				S3M	2163	16.7 ± 0.0	NB
A	*Calidris melanotos*	Pectoral Sandpiper				S3M	425	16.6 ± 0.0	NB
A	*Limnodromus griseus*	Short-billed Dowitcher				S3M	1237	16.6 ± 0.0	NB
A	*Phalaropus fulicarius*	Red Phalarope				S3M	3	41.5 ± 11.0	NB
A	*Bucephala albeola*	Bufflehead				S3N	364	16.6 ± 0.0	NB
A	*Calidris maritima*	Purple Sandpiper				S3N	105	18.7 ± 0.0	NB
A	*Uria lomvia*	Thick-billed Murre				S3N,S3M	3	59.9 ± 0.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
A	*Perisoreus canadensis*	Canada Jay				S3S4	620	8.6 ± 7.0	NB
A	*Poecile hudsonicus*	Boreal Chickadee				S3S4	376	8.6 ± 7.0	NB
A	*Eptesicus fuscus*	Big Brown Bat				S3S4	27	33.5 ± 1.0	NB
A	*Synaptomys cooperi*	Southern Bog Lemming				S3S4	101	29.7 ± 1.0	NB
A	*Tyrannus tyrannus*	Eastern Kingbird				S3S4B	744	5.2 ± 7.0	NB
A	*Vireo gilvus*	Warbling Vireo				S3S4B	267	14.4 ± 0.0	NB
A	*Actitis macularius*	Spotted Sandpiper				S3S4B,S4M	1006	2.4 ± 0.0	NB
A	*Melospiza lincolnii*	Lincoln's Sparrow				S3S4B,S4M	454	8.6 ± 7.0	NB
A	*Gallinago delicata*	Wilson's Snipe				S3S4B,S5M	1501	5.3 ± 7.0	NB
A	*Setophaga striata*	Blackpoll Warbler				S3S4B,S5M	75	22.4 ± 0.0	NB
A	*Pluvialis squatarola*	Black-bellied Plover				S3S4M	1607	41.1 ± 0.0	NB
A	*Morus bassanus*	Northern Gannet				SHB	141	41.5 ± 11.0	NB
C	*Quercus macrocarpa - Acer rubrum / Onoclea sensibilis - Carex arcta Forest*	Bur Oak - Red Maple / Sensitive Fern - Northern Clustered Sedge Forest				S2	1	74.7 ± 0.0	NB
C	*Acer saccharum - Fraxinus americana / Polystichum acrostichoides Forest*	Sugar Maple - White Ash / Christmas Fern Forest				S3S4	1	74.0 ± 0.0	NB
I	*Bombus bohemicus*	Ashton Cuckoo Bumble Bee	Endangered	Endangered		S1	11	36.6 ± 5.0	NB
I	*Gomphurus ventricosus*	Skillet Clubtail	Endangered	Endangered	Endangered	S2	18	27.5 ± 0.0	NB
I	*Danaus plexippus*	Monarch	Endangered	Special Concern	Special Concern	S2S3?B	301	8.0 ± 0.0	NB
I	*Bombus suckleyi*	Suckley's Cuckoo Bumble Bee	Threatened			SH	1	97.6 ± 5.0	NB
I	*Cicindela marginipennis*	Cobblestone Tiger Beetle	Special Concern	Endangered	Endangered	S2S3	198	59.9 ± 0.0	NB
I	*Ophiogomphus howei*	Pygmy Snaketail	Special Concern	Special Concern	Special Concern	S2S3	13	58.5 ± 0.0	NB
I	*Alasmidonta varicosa*	Brook Floater	Special Concern	Special Concern	Special Concern	S3	34	4.0 ± 1.0	NB
I	*Lampsilis cariosa*	Yellow Lampmussel	Special Concern	Special Concern	Special Concern	S3	75	34.3 ± 0.0	NB
I	*Bombus terricola*	Yellow-banded Bumble Bee	Special Concern	Special Concern		S4	184	10.0 ± 0.0	NB
I	*Coccinella transversoguttata richardsoni*	Transverse Lady Beetle	Special Concern			SH	28	24.1 ± 2.0	NB
I	*Appalachina sayana sayana*	Spike-lip Crater Snail	Not At Risk			S3?	2	57.2 ± 1.0	NB
I	*Erora laeta*	Early Hairstreak				S1	1	38.6 ± 1.0	NB
I	*Leucorrhinia patricia*	Canada Whiteface				S1	10	98.1 ± 1.0	NB
I	*Polites origenes*	Crossline Skipper				S1?	6	73.4 ± 0.0	NB
I	*Icaricia saepiolus*	Greenish Blue				S1S2	2	4.3 ± 2.0	NB
I	*Pachydiplax longipennis*	Blue Dasher				S1S2	1	83.6 ± 0.0	NB
I	*Cicindela ancocisconensis*	Appalachian Tiger Beetle				S2	2	56.1 ± 0.0	NB
I	*Scaphinotus viduus*	Bereft Snail-eating Beetle				S2	2	75.8 ± 0.0	NB
I	*Brachyleptura circumdata*	Dark-shouldered Long-horned Beetle				S2	6	81.6 ± 0.0	NB
I	*Satyrium calanus*	Banded Hairstreak				S2	2	83.5 ± 1.0	NB
I	*Strymon melinus*	Gray Hairstreak				S2	2	37.0 ± 2.0	NB
I	*Somatochlora brevicincta*	Quebec Emerald				S2	2	36.8 ± 0.0	NB
I	*Ophiogomphus colubrinus*	Boreal Snaketail				S2S3	2	79.4 ± 0.0	NB
I	*Sphaeroderus nitidicollis*	Polished Snail-eating Beetle				S3	1	81.7 ± 0.0	NB
I	*Lepturopsis biforis*	Two-spotted Long-horned Beetle				S3	1	98.7 ± 1.0	NB
I	*Orthosoma brunneum*	Moist Long-horned Beetle				S3	1	72.1 ± 5.0	NB
I	*Psyrassa unicolor*	Unicoloured Long-horned Beetle				S3	1	68.5 ± 0.0	NB
I	*Elaphrus americanus*	Boreal Elaphrus Beetle				S3	2	43.9 ± 0.0	NB
I	*Desmocerus palliatus*	Elderberry Borer				S3	8	70.8 ± 0.0	NB
I	*Agonum crenistriatum*	Scalloped Harp Ground Beetle				S3	1	39.3 ± 1.0	NB
I	*Agonum consimile*	Consimile Ground Beetle				S3	1	39.3 ± 1.0	NB
I	*Agonum excavatum*	Excavated Harp Ground Beetle				S3	1	93.4 ± 0.0	NB
I	*Clivina americana*	America Pedunculate				S3	1	93.4 ± 0.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
		Ground Beetle							
I	*Lachnocrepis parallela*	Swamp Harp Ground Beetle				S3	1	48.2 ± 0.0	NB
I	*Dyschirius setosus*	Bristly Pedunculate Ground Beetle				S3	3	48.2 ± 0.0	NB
I	*Harpalus fulvilabris*	Fulvia Harpaline Beetle				S3	1	44.3 ± 0.0	NB
I	*Olisthopus parmatus*	Tawny-bordered Harp Ground Beetle				S3	2	77.8 ± 0.0	NB
I	*Tachys scitulus*	Handsome Riverbank Ground Beetle				S3	1	93.4 ± 0.0	NB
I	*Amara pallipes*	Pale-footed Sun Beetle				S3	2	39.3 ± 1.0	NB
I	*Carabus maeander*	Meander Ground Beetle				S3	1	39.3 ± 1.0	NB
I	*Carabus serratus*	Serrated Ground Beetle				S3	2	34.8 ± 1.0	NB
I	*Coccinella hieroglyphica kirbyi*	a Ladybird Beetle				S3	1	98.7 ± 1.0	NB
I	*Hippodamia parenthesis*	Parenthesis Lady Beetle				S3	16	33.9 ± 0.0	NB
I	*Stenocorus vittiger*	Shrub Long-horned Beetle				S3	1	93.4 ± 0.0	NB
I	*Gnathacmaeops pratensis*	Meadow Flower Longhorn Beetle				S3	5	98.7 ± 1.0	NB
I	*Pogonocherus mixtus*	Mixed-spotted Flatface Sawyer				S3	1	98.7 ± 1.0	NB
I	*Xylotrechus undulatus*	Spruce Zebra Beetle				S3	2	52.6 ± 1.0	NB
I	*Badister neopulchellus*	Red-black Spotted Beetle				S3	1	93.4 ± 0.0	NB
I	*Calathus gregarius*	Gregarious Harp Ground Beetle				S3	1	38.2 ± 1.0	NB
I	*Gonioctena americana*	American Aspen Beetle				S3	1	48.5 ± 0.0	NB
I	*Naemia seriata*	Seaside Lady Beetle				S3	10	49.0 ± 0.0	NB
I	*Beckerus appressus*	Compressed Click Beetle				S3	1	34.6 ± 0.0	NB
I	*Saperda lateralis*	Red-edged Long-horned Beetle				S3	1	88.0 ± 0.0	NS
I	*Trachysida aspera*	Rough Flower Longhorn Beetle				S3	1	44.0 ± 0.0	NB
I	*Dicerca caudata*	Tailed Jewel Borer				S3	1	87.7 ± 0.0	NB
I	*Enoclerus muttkowskii*	Muttkowski's Checkered Beetle				S3	2	26.0 ± 0.0	NB
I	*Epargyreus clarus*	Silver-spotted Skipper				S3	9	63.6 ± 0.0	NB
I	*Hesperia sassacus*	Indian Skipper				S3	9	8.0 ± 0.0	NB
I	*Euphyes bimacula*	Two-spotted Skipper				S3	21	36.4 ± 1.0	NB
I	*Papilio brevicauda bretonensis*	Short-tailed Swallowtail				S3	13	75.5 ± 0.0	NB
I	*Tharsalea dospassosi*	Maritime Copper				S3	58	63.5 ± 0.0	NB
I	*Satyrium acadica*	Acadian Hairstreak				S3	22	32.6 ± 2.0	NB
I	*Plebejus idas*	Northern Blue				S3	6	60.3 ± 0.0	NS
I	*Plebejus idas empetri*	Crowberry Blue				S3	22	41.6 ± 20.0	NB
I	*Argynnis aphrodite*	Aphrodite Fritillary				S3	27	38.2 ± 0.0	NB
I	*Boloria bellona*	Meadow Fritillary				S3	25	56.6 ± 0.0	NB
I	*Boloria chariclea*	Arctic Fritillary				S3	11	57.5 ± 7.0	NB
I	*Nymphalis l-album*	Compton Tortoiseshell				S3	17	35.2 ± 7.0	NB
I	*Gomphurus vastus*	Cobra Clubtail				S3	38	58.0 ± 0.0	NB
I	*Celithemis martha*	Martha's Pennant				S3	1	94.1 ± 0.0	NB
I	*Ladona exusta*	White Corporal				S3	1	88.2 ± 0.0	NB
I	*Enallagma pictum*	Scarlet Bluet				S3	2	88.1 ± 0.0	NB
I	*Arigomphus furcifer*	Lilypad Clubtail				S3	20	64.3 ± 0.0	NB
I	*Alasmidonta undulata*	Triangle Floater				S3	58	3.1 ± 1.0	NB
I	*Atlanticoncha ochracea*	Tidewater Mucket				S3	159	40.7 ± 0.0	NB
I	*Neohelix albolabris*	Whitelip Snail				S3	1	49.1 ± 0.0	NB
I	*Spurwinkia salsa*	Saltmarsh Hydrobe				S3	22	76.1 ± 0.0	NB
I	*Pantala hymenaea*	Spot-Winged Glider				S3B	5	44.8 ± 0.0	NB
I	*Collops vittatus*	Banded Soft-winged Flower				S3S4	1	40.4 ± 3.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
		Beetle							
I	*Hemicrepidius memnonius*	Memnon's Click Beetle				S3S4	3	68.5 ± 0.0	NB
I	*Bolitophagus corticola*	Corticolous Darkling Beetle				S3S4	1	68.5 ± 0.0	NB
I	*Bombus griseocollis*	Brown-belted Bumble Bee				S3S4	4	37.0 ± 0.0	NB
I	*Lanthus vernalis*	Southern Pygmy Clubtail				S3S4	1	11.8 ± 0.0	NB
I	*Somatochlora forcipata*	Forcipate Emerald				S3S4	9	34.3 ± 1.0	NB
I	*Somatochlora tenebrosa*	Clamp-Tipped Emerald				S3S4	11	31.8 ± 0.0	NB
N	*Erioderma mollissimum*	Graceful Felt Lichen	Endangered	Endangered	Endangered	SH	2	46.9 ± 1.0	NB
N	*Erioderma pedicellatum (Atlantic pop.)*	Boreal Felt Lichen - Atlantic pop.	Endangered	Endangered	Endangered	SH	2	66.1 ± 0.0	NS
N	*Pannaria lurida*	Wrinkled Shingle Lichen	Threatened	Threatened		S1?	2	63.8 ± 1.0	NB
N	*Anzia colpodes*	Black-foam Lichen	Threatened	Threatened		S1S2	13	18.1 ± 1.0	NB
N	*Fuscopannaria leucosticta*	White-rimmed Shingle Lichen	Threatened			S2	16	47.9 ± 0.0	NB
N	*Peltigera hydrothyria*	Eastern Waterfan	Threatened	Threatened		S2S3	775	21.4 ± 0.0	NB
N	*Pectenia plumbea*	Blue Felt Lichen	Special Concern	Special Concern	Special Concern	S1	15	64.0 ± 1.0	NS
N	*Pseudevernia cladonia*	Ghost Antler Lichen	Not At Risk			S2S3	20	40.4 ± 0.0	NB
N	*Aloina rigida*	Aloe-Like Rigid Screw Moss				S1	1	58.7 ± 0.0	NB
N	*Imbribryum muehlenbeckii*	Muehlenbeck's Bryum Moss				S1	1	99.6 ± 1.0	NB
N	*Dicranoweisia crispula*	Mountain Thatch Moss				S1	1	41.2 ± 0.0	NB
N	*Didymodon rigidulus var. gracilis*	a moss				S1	1	46.4 ± 1.0	NB
N	*Syntrichia ruralis*	a Moss				S1	1	30.9 ± 0.0	NB
N	*Sticta fuliginosa*	Peppered Moon Lichen				S1	14	66.0 ± 0.0	NS
N	*Cladonia straminea*	Reptilian Pixie-cup Lichen				S1	5	36.0 ± 1.0	NB
N	*Coccocarpia palmicola*	Salted Shell Lichen				S1	1	36.0 ± 1.0	NB
N	*Peltigera malacea*	Veinless Pelt Lichen				S1	1	40.8 ± 1.0	NB
N	*Bryoria bicolor*	Electrified Horsehair Lichen				S1	1	40.8 ± 1.0	NB
N	*Hygrobiella laxifolia*	Lax Notchwort				S1?	1	40.2 ± 1.0	NB
N	*Bartramia ithyphylla*	Straight-leaved Apple Moss				S1?	2	40.2 ± 0.0	NB
N	*Ptychostomum pallens*	Pale Bryum				S1?	1	93.6 ± 0.0	NS
N	*Dicranum bonjeanii*	Bonjean's Broom Moss				S1?	1	96.6 ± 0.0	NS
N	*Dicranum condensatum*	Condensed Broom Moss				S1?	1	41.1 ± 0.0	NB
N	*Entodon brevisetus*	a Moss				S1?	1	28.2 ± 10.0	NB
N	*Oxyrrhynchium hians*	Light Beaked Moss				S1?	1	34.9 ± 0.0	NB
N	*Homomallium adnatum*	Adnate Hairy-gray Moss				S1?	3	14.5 ± 1.0	NB
N	*Plagiothecium latebricola*	Alder Silk Moss				S1?	2	45.5 ± 1.0	NB
N	*Rhytidium rugosum*	Wrinkle-leaved Moss				S1?	2	35.1 ± 0.0	NB
N	*Splachnum pensylvanicum*	Southern Dung Moss				S1?	1	86.7 ± 1.0	NB
N	*Enchylium tenax*	Soil Tarpaper Lichen				S1?	1	78.1 ± 0.0	NS
N	*Ephebe perspinulosa*	Thread Lichen				S1?	1	97.1 ± 1.0	NS
N	*Heterodermia squamulosa*	Scaly Fringe Lichen				S1?	75	68.5 ± 1.0	NS
N	*Pertusaria propinqua*	a Lichen				S1?	2	40.8 ± 1.0	NB
N	*Rhizocarpon umbilicatum*	a Lichen				S1?	2	32.5 ± 1.0	NB
N	*Cephaloziella spinigera*	Spiny Threadwort				S1S2	2	38.5 ± 0.0	NB
N	*Odontoschisma francisci*	Holt's Notchwort				S1S2	4	34.7 ± 1.0	NB
N	*Harpanthus flotovianus*	Great Mountain Flapwort				S1S2	2	32.0 ± 1.0	NB
N	*Pallavicinia lyellii*	Lyell's Ribbonwort				S1S2	4	28.2 ± 1.0	NB
N	*Radula tenax*	Tenacious Scalewort				S1S2	1	44.1 ± 0.0	NB
N	*Reboulia hemisphaerica*	Purple-margined Liverwort				S1S2	1	46.4 ± 0.0	NB
N	*Solenostoma obovatum*	Egg Flapwort				S1S2	2	44.1 ± 0.0	NB
N	*Brachythecium acuminatum*	Acuminate Ragged Moss				S1S2	3	42.4 ± 2.0	NB
N	*Ptychostomum salinum*	Saltmarsh Bryum				S1S2	1	45.5 ± 1.0	NB
N	*Tortula obtusifolia*	a Moss				S1S2	1	68.5 ± 0.0	NB
N	*Distichium inclinatum*	Inclined Iris Moss				S1S2	5	46.4 ± 1.0	NB
N	*Ditrichum pallidum*	Pale Cow-hair Moss				S1S2	1	19.1 ± 1.0	NB
N	*Timmia norvegica*	a moss				S1S2	3	45.7 ± 0.0	NB
N	*Timmia norvegica var.*	a moss				S1S2	1	46.5 ± 0.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
	excurrens								
N	*Tortella humilis*	Small Crisp Moss				S1S2	7	31.9 ± 1.0	NB
N	*Pseudotaxiphyllum distichaceum*	a Moss				S1S2	2	55.7 ± 1.0	NB
N	*Hamatocaulis vernicosus*	a Moss				S1S2	1	79.4 ± 100.0	NB
N	*Umbilicaria vellea*	Grizzled Rocktripe Lichen				S1S2	1	45.9 ± 1.0	NB
N	*Pilophorus cereolus*	Powdered Matchstick Lichen				S1S2	1	37.4 ± 5.0	NB
N	*Peltigera scabrosa*	Greater Toad Pelt Lichen				S1S2	4	32.5 ± 1.0	NB
N	*Calypogeia neesiana*	Nees' Pouchwort				S1S3	1	74.7 ± 1.0	NB
N	*Fuscocephaloziopsis connivens*	Forcipated Pincerwort				S1S3	1	85.7 ± 0.0	NB
N	*Porella pinnata*	Pinnate Scalewort				S1S3	1	68.5 ± 1.0	NB
N	*Tritomaria scitula*	Mountain Notchwort				S1S3	1	41.5 ± 1.0	NB
N	*Amphidium mougeotii*	a Moss				S2	14	37.6 ± 0.0	NB
N	*Anomodon viticulosus*	a Moss				S2	5	10.1 ± 10.0	NB
N	*Cirriphyllum piliferum*	Hair-pointed Moss				S2	4	4.2 ± 5.0	NB
N	*Dicranella palustris*	Drooping-Leaved Fork Moss				S2	9	32.7 ± 5.0	NB
N	*Didymodon ferrugineus*	Rusty Beard Moss				S2	2	46.2 ± 0.0	NB
N	*Ditrichum flexicaule*	Flexible Cow-hair Moss				S2	1	86.6 ± 1.0	NB
N	*Anomodon tristis*	a Moss				S2	9	38.2 ± 10.0	NB
N	*Hygrohypnum bestii*	Best's Brook Moss				S2	5	20.3 ± 0.0	NB
N	*Isothecium myosuroides*	Slender Mouse-tail Moss				S2	3	86.6 ± 1.0	NB
N	*Meesia triquetra*	Three-ranked Cold Moss				S2	1	58.1 ± 100.0	NB
N	*Physcomitrium immersum*	a Moss				S2	1	68.5 ± 1.0	NB
N	*Platydictya jungermannioides*	False Willow Moss				S2	4	22.8 ± 15.0	NB
N	*Pohlia elongata*	Long-necked Nodding Moss				S2	10	35.0 ± 0.0	NB
N	*Seligeria calcarea*	Chalk Brittle Moss				S2	3	33.2 ± 0.0	NB
N	*Seligeria recurvata*	a Moss				S2	3	14.5 ± 1.0	NB
N	*Sphagnum lindbergii*	Lindberg's Peat Moss				S2	4	77.1 ± 5.0	NB
N	*Sphagnum flexuosum*	Flexuous Peatmoss				S2	4	34.8 ± 0.0	NB
N	*Tayloria serrata*	Serrate Trumpet Moss				S2	8	19.6 ± 1.0	NB
N	*Tetrodontium brownianum*	Little Georgia				S2	8	38.1 ± 10.0	NB
N	*Thamnobryum alleghaniense*	a Moss				S2	24	29.2 ± 0.0	NB
N	*Ulota phyllantha*	a Moss				S2	4	46.2 ± 0.0	NB
N	*Anomobryum julaceum*	Slender Silver Moss				S2	4	46.4 ± 1.0	NB
N	*Cladonia macrophylla*	Fig-leaved Lichen				S2	3	39.6 ± 1.0	NB
N	*Leptogium corticola*	Blistered Jellyskin Lichen				S2	1	80.2 ± 0.0	NB
N	*Leptogium milligranum*	Stretched Jellyskin Lichen				S2	1	62.4 ± 0.0	NB
N	*Nephroma laevigatum*	Mustard Kidney Lichen				S2	12	64.7 ± 2.0	NS
N	*Anacamptodon splachnoides*	a Moss				S2?	1	80.2 ± 1.0	NB
N	*Andreaea rothii*	Dusky Rock Moss				S2?	6	37.6 ± 0.0	NB
N	*Anomodon minor*	Blunt-leaved Anomodon Moss				S2?	1	11.4 ± 1.0	NB
N	*Ptychostomum pallescens*	Tall Clustered Bryum				S2?	1	80.1 ± 100.0	NB
N	*Dichelyma capillaceum*	Hairlike Dichelyma Moss				S2?	1	28.4 ± 3.0	NB
N	*Hygrohypnum montanum*	a Moss				S2?	2	35.2 ± 1.0	NB
N	*Schistostega pennata*	Luminous Moss				S2?	2	53.6 ± 100.0	NB
N	*Seligeria diversifolia*	a Moss				S2?	2	62.3 ± 0.0	NB
N	*Sphagnum angermanicum*	a Peatmoss				S2?	1	30.1 ± 10.0	NB
N	*Trichodon cylindricus*	Cylindric Hairy-teeth Moss				S2?	3	14.5 ± 10.0	NB
N	*Plagiomnium rostratum*	Long-beaked Leafy Moss				S2?	6	29.2 ± 0.0	NB
N	*Ramalina labiosorediata*	Chalky Ramalina Lichen				S2?	1	45.2 ± 1.0	NB
N	*Nephroma arcticum*	Arctic Kidney Lichen				S2?	2	39.0 ± 1.0	NB
N	*Ptychostomum cernuum*	Swamp Bryum				S2S3	2	46.2 ± 0.0	NB
N	*Buxbaumia aphylla*	Brown Shield Moss				S2S3	1	99.9 ± 0.0	NB
N	*Calliergonella cuspidata*	Common Large Wetland Moss				S2S3	6	18.2 ± 5.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
N	*Drepanocladus polygamus*	Polygamous Hook Moss				S2S3	1	35.0 ± 0.0	NB
N	*Palustriella falcata*	Curled Hook Moss				S2S3	3	39.3 ± 0.0	NB
N	*Didymodon rigidulus*	Rigid Screw Moss				S2S3	8	42.4 ± 2.0	NB
N	*Ephemerum serratum*	a Moss				S2S3	4	29.7 ± 0.0	NB
N	*Isopterygiopsis pulchella*	Neat Silk Moss				S2S3	8	37.6 ± 1.0	NB
N	*Neckera complanata*	a Moss				S2S3	5	86.6 ± 1.0	NB
N	*Orthotrichum elegans*	Showy Bristle Moss				S2S3	1	18.2 ± 0.0	NB
N	*Pohlia proligera*	Cottony Nodding Moss				S2S3	5	22.8 ± 15.0	NB
N	*Codriophorus fascicularis*	Clustered Rock Moss				S2S3	3	39.5 ± 0.0	NB
N	*Bucklandiella affinis*	Lesser Rock Moss				S2S3	11	34.0 ± 1.0	NB
N	*Saelania glaucescens*	Blue Dew Moss				S2S3	2	41.2 ± 0.0	NB
N	*Scorpidium scorpioides*	Hooked Scorpion Moss				S2S3	3	89.1 ± 0.0	NB
N	*Seligeria campylopoda*	a Moss				S2S3	1	79.4 ± 100.0	NB
N	*Sphagnum centrale*	Central Peat Moss				S2S3	7	34.7 ± 1.0	NB
N	*Sphagnum subfulvum*	a Peatmoss				S2S3	2	98.1 ± 0.0	NB
N	*Taxiphyllum deplanatum*	Imbricate Yew-leaved Moss				S2S3	2	43.8 ± 1.0	NB
N	*Zygodon viridissimus*	a Moss				S2S3	3	43.8 ± 1.0	NB
N	*Schistidium agassizii*	Elf Bloom Moss				S2S3	3	34.1 ± 1.0	NB
N	*Loeskeobryum brevirostre*	a Moss				S2S3	16	28.4 ± 2.0	NB
N	*Cyrtomnium hymenophylloides*	Short-pointed Lantern Moss				S2S3	7	33.4 ± 0.0	NB
N	*Sphaerophorus globosus*	Northern Coral Lichen				S2S3	13	35.6 ± 0.0	NB
N	*Cetrariella delisei*	Snowbed Icelandmoss Lichen				S2S3	2	31.1 ± 0.0	NB
N	*Cladonia acuminata*	Scantily Clad Pixie Lichen				S2S3	2	45.9 ± 1.0	NB
N	*Cladonia ramulosa*	Bran Lichen				S2S3	4	40.8 ± 1.0	NB
N	*Cladonia sulphurina*	Greater Sulphur-cup Lichen				S2S3	5	34.1 ± 0.0	NB
N	*Parmeliopsis ambigua*	Green Starburst Lichen				S2S3	1	46.2 ± 1.0	NB
N	*Polychidium muscicola*	Eyed Mossthorns Woollybear Lichen				S2S3	7	38.9 ± 0.0	NB
N	*Hypnum curvifolium*	Curved-leaved Plait Moss				S3	14	37.6 ± 1.0	NB
N	*Tortella fragilis*	Fragile Twisted Moss				S3	1	46.5 ± 0.0	NB
N	*Schistidium maritimum*	a Moss				S3	5	45.2 ± 0.0	NB
N	*Hymenostylium recurvirostrum*	Curve-beak Beardless Moss				S3	7	46.7 ± 1.0	NB
N	*Collema nigrescens*	Blistered Tarpaper Lichen				S3	1	66.3 ± 3.0	NS
N	*Solorina saccata*	Woodland Owl Lichen				S3	6	45.9 ± 1.0	NB
N	*Ahtiana aurescens*	Eastern Candlewax Lichen				S3	2	97.8 ± 0.0	NB
N	*Normandina pulchella*	Rimmed Elf-ear Lichen				S3	21	40.8 ± 1.0	NB
N	*Cladonia farinacea*	Farinose Pixie Lichen				S3	5	41.3 ± 1.0	NB
N	*Cladonia strepsilis*	Olive Cladonia Lichen				S3	1	67.6 ± 0.0	NB
N	*Hypotrachyna catawbiensis*	Powder-tipped Antler Lichen				S3	17	44.8 ± 0.0	NB
N	*Scytinium lichenoides*	Tattered Jellyskin Lichen				S3	6	45.9 ± 1.0	NB
N	*Nephroma bellum*	Naked Kidney Lichen				S3	4	34.8 ± 1.0	NB
N	*Peltigera degenii*	Lustrous Pelt Lichen				S3	3	36.9 ± 1.0	NB
N	*Leptogium laceroides*	Short-bearded Jellyskin Lichen				S3	8	34.0 ± 1.0	NB
N	*Peltigera membranacea*	Membranous Pelt Lichen				S3	20	23.0 ± 0.0	NB
N	*Cladonia botrytes*	Wooden Soldiers Lichen				S3	1	31.6 ± 0.0	NB
N	*Cladonia carneola*	Crowned Pixie-cup Lichen				S3	2	41.3 ± 1.0	NB
N	*Cladonia deformis*	Lesser Sulphur-cup Lichen				S3	9	31.5 ± 0.0	NB
N	*Aulacomnium androgynum*	Little Groove Moss				S3?	6	22.8 ± 15.0	NB
N	*Ptychostomum inclinatum*	Blunt-tooth Thread Moss				S3?	2	46.2 ± 0.0	NB
N	*Dicranella rufescens*	Red Forklet Moss				S3?	1	46.5 ± 0.0	NB
N	*Rhytidiadelphus loreus*	Lanky Moss				S3?	4	44.6 ± 0.0	NB
N	*Sphagnum lescurii*	a Peatmoss				S3?	6	31.5 ± 1.0	NB
N	*Sphagnum inundatum*	a Sphagnum				S3?	2	73.7 ± 0.0	NB
N	*Rostania occultata*	Crusted Tarpaper Lichen				S3?	3	64.1 ± 3.0	NS

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N	*Scytinium subtile*	Appressed Jellyskin Lichen				S3?	4	78.7 ± 0.0	NB
N	*Peltigera neckeri*	Black-saddle Pelt Lichen				S3?	1	38.7 ± 5.0	NB
N	*Stereocaulon subcoralloides*	Coralloid Foam Lichen				S3?	1	45.2 ± 1.0	NB
N	*Anomodon rugelii*	Rugel's Anomodon Moss				S3S4	1	95.5 ± 3.0	NS
N	*Barbula convoluta*	Lesser Bird's-claw Beard Moss				S3S4	1	46.7 ± 15.0	NB
N	*Brachytheciastrum velutinum*	Velvet Ragged Moss				S3S4	1	34.2 ± 1.0	NB
N	*Dicranella cerviculata*	a Moss				S3S4	3	33.7 ± 2.0	NB
N	*Dicranella varia*	a Moss				S3S4	1	92.6 ± 3.0	NS
N	*Dicranum majus*	Greater Broom Moss				S3S4	22	33.4 ± 0.0	NB
N	*Dicranum leioneuron*	a Dicranum Moss				S3S4	2	37.3 ± 0.0	NB
N	*Encalypta ciliata*	Fringed Extinguisher Moss				S3S4	2	46.2 ± 0.0	NB
N	*Fissidens bryoides*	Lesser Pocket Moss				S3S4	4	45.2 ± 0.0	NB
N	*Elodium blandowii*	Blandow's Bog Moss				S3S4	1	95.4 ± 0.0	NB
N	*Heterocladium dimorphum*	Dimorphous Tangle Moss				S3S4	5	18.2 ± 0.0	NB
N	*Isopterygiopsis muelleriana*	a Moss				S3S4	21	33.4 ± 0.0	NB
N	*Myurella julacea*	Small Mouse-tail Moss				S3S4	3	46.3 ± 0.0	NB
N	*Orthotrichum speciosum*	Showy Bristle Moss				S3S4	2	81.7 ± 4.0	NB
N	*Physcomitrium pyriforme*	Pear-shaped Urn Moss				S3S4	4	33.5 ± 0.0	NB
N	*Pogonatum dentatum*	Mountain Hair Moss				S3S4	3	46.2 ± 0.0	NB
N	*Sphagnum compactum*	Compact Peat Moss				S3S4	1	61.7 ± 0.0	NB
N	*Sphagnum torreyanum*	a Peatmoss				S3S4	2	48.6 ± 0.0	NB
N	*Sphagnum austinii*	Austin's Peat Moss				S3S4	1	82.9 ± 0.0	NS
N	*Sphagnum contortum*	Twisted Peat Moss				S3S4	2	89.0 ± 0.0	NB
N	*Sphagnum quinquefarium*	Five-ranked Peat Moss				S3S4	3	18.2 ± 0.0	NB
N	*Splachnum rubrum*	Red Collar Moss				S3S4	1	85.5 ± 1.0	NB
N	*Tetraphis geniculata*	Geniculate Four-tooth Moss				S3S4	14	34.1 ± 1.0	NB
N	*Tetraplodon angustatus*	Toothed-leaved Nitrogen Moss				S3S4	2	65.3 ± 0.0	NS
N	*Weissia controversa*	Green-Cushioned Weissia				S3S4	2	46.7 ± 1.0	NB
N	*Abietinella abietina*	Wiry Fern Moss				S3S4	1	46.5 ± 0.0	NB
N	*Trichostomum tenuirostre*	Acid-Soil Moss				S3S4	5	39.5 ± 0.0	NB
N	*Rauiella scita*	Smaller Fern Moss				S3S4	1	95.6 ± 0.0	NB
N	*Pannaria rubiginosa*	Brown-eyed Shingle Lichen				S3S4	11	45.5 ± 1.0	NB
N	*Pseudocyphellaria holarctica*	Yellow Specklebelly Lichen				S3S4	75	16.0 ± 0.0	NB
N	*Ramalina thrausta*	Angelhair Ramalina Lichen				S3S4	12	32.5 ± 1.0	NB
N	*Hypogymnia vittata*	Slender Monk's Hood Lichen				S3S4	28	34.5 ± 1.0	NB
N	*Scytinium teretiusculum*	Curly Jellyskin Lichen				S3S4	4	97.8 ± 0.0	NS
N	*Montanelia panniformis*	Shingled Camouflage Lichen				S3S4	5	35.3 ± 1.0	NB
N	*Cladonia floerkeana*	Gritty British Soldiers Lichen				S3S4	5	34.5 ± 1.0	NB
N	*Xylopsora friesii*	a Lichen				S3S4	1	45.9 ± 1.0	NB
N	*Nephroma parile*	Powdery Kidney Lichen				S3S4	14	16.8 ± 0.0	NB
N	*Protopannaria pezizoides*	Brown-gray Moss-shingle Lichen				S3S4	22	22.8 ± 0.0	NB
N	*Usnea strigosa*	Bushy Beard Lichen				S3S4	32	43.0 ± 0.0	NB
N	*Stereocaulon condensatum*	Granular Soil Foam Lichen				S3S4	9	36.7 ± 0.0	NB
N	*Stereocaulon paschale*	Easter Foam Lichen				S3S4	2	69.0 ± 1.0	NB
N	*Pannaria conoplea*	Mealy-rimmed Shingle Lichen				S3S4	11	42.8 ± 0.0	NB
N	*Physcia tenella*	Fringed Rosette Lichen				S3S4	2	43.7 ± 0.0	NB
N	*Anaptychia palmulata*	Shaggy Fringed Lichen				S3S4	72	34.0 ± 1.0	NB
N	*Peltigera neopolydactyla*	Undulating Pelt Lichen				S3S4	9	35.3 ± 1.0	NB
N	*Cladonia cariosa*	Lesser Ribbed Pixie Lichen				S3S4	4	44.1 ± 1.0	NB
N	*Hypocenomyce scalaris*	Common Clam Lichen				S3S4	1	45.2 ± 1.0	NB
N	*Grimmia anodon*	Toothless Grimmia Moss				SH	2	98.6 ± 10.0	NB
N	*Leucodon brachypus*	a Moss				SH	9	34.6 ± 0.0	NB
N	*Splachnum luteum*	Yellow Collar Moss				SH	1	80.1 ± 100.0	NB
N	*Thelia hirtella*	a Moss				SH	1	58.1 ± 100.0	NB

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N	*Cyrto-hypnum minutulum*	Tiny Cedar Moss				SH	3	32.3 ± 10.0	NB
P	*Juglans cinerea*	Butternut	Endangered	Endangered	Endangered	S1	114	10.0 ± 2.0	NB
P	*Symphyotrichum laurentianum*	Gulf of St Lawrence Aster	Threatened	Threatened	Endangered	S1	7	95.4 ± 0.0	NB
P	*Fraxinus nigra*	Black Ash	Threatened			S3S4	220	1.5 ± 0.0	NB
P	*Isoetes prototypus*	Prototype Quillwort	Special Concern	Special Concern	Endangered	S1	1	97.0 ± 0.0	NB
P	*Lechea maritima var. subcylindrica*	Beach Pinweed	Special Concern	Special Concern	Special Concern	S2	2340	75.1 ± 0.0	NB
P	*Symphyotrichum subulatum (Bathurst pop)*	Bathurst Aster - Bathurst pop.	Not At Risk		Endangered	S2	20	80.8 ± 0.0	NB
P	*Cryptotaenia canadensis*	Canada Honewort				S1	2	32.5 ± 1.0	NB
P	*Antennaria parlinii ssp. fallax*	Parlin's Pussytoes				S1	5	64.4 ± 1.0	NB
P	*Bidens discoidea*	Swamp Beggarticks				S1	4	56.1 ± 0.0	NB
P	*Pseudognaphalium obtusifolium*	Eastern Cudweed				S1	7	51.4 ± 1.0	NB
P	*Hieracium paniculatum*	Panicled Hawkweed				S1	4	59.5 ± 0.0	NB
P	*Solidago multiradiata*	Multi-rayed Goldenrod				S1	19	41.4 ± 0.0	NB
P	*Barbarea orthoceras*	American Yellow Rocket				S1	1	41.1 ± 1.0	NB
P	*Cardamine parviflora*	Small-flowered Bittercress				S1	10	75.2 ± 0.0	NB
P	*Draba arabisans*	Rock Whitlow-Grass				S1	36	42.1 ± 0.0	NB
P	*Draba glabella*	Rock Whitlow-Grass				S1	13	46.3 ± 0.0	NB
P	*Stellaria crassifolia*	Fleshy Stitchwort				S1	2	62.5 ± 5.0	NB
P	*Chenopodiastrum simplex*	Maple-leaved Goosefoot				S1	6	4.3 ± 5.0	NB
P	*Blitum capitatum*	Strawberry-Blite				S1	3	57.8 ± 1.0	NB
P	*Suaeda rolandii*	Roland's Sea-Blite				S1	17	43.4 ± 0.0	NB
P	*Hypericum virginicum*	Virginia St. John's-wort				S1	3	86.8 ± 0.0	NS
P	*Vaccinium boreale*	Northern Blueberry				S1	4	59.0 ± 0.0	NS
P	*Vaccinium corymbosum*	Highbush Blueberry				S1	1	80.4 ± 0.0	NS
P	*Euphorbia polygonifolia*	Seaside Spurge				S1	1	98.3 ± 10.0	NB
P	*Lespedeza capitata*	Round-headed Bush-clover				S1	11	60.5 ± 0.0	NB
P	*Proserpinaca pectinata*	Comb-leaved Mermaidweed				S1	2	83.4 ± 5.0	NS
P	*Pycnanthemum virginianum*	Virginia Mountain Mint				S1	4	69.0 ± 0.0	NB
P	*Polygonum douglasii*	Douglas Knotweed				S1	1	31.3 ± 0.0	NB
P	*Lysimachia quadrifolia*	Whorled Yellow Loosestrife				S1	11	58.6 ± 0.0	NB
P	*Primula laurentiana*	Laurentian Primrose				S1	64	38.6 ± 3.0	NB
P	*Amelanchier fernaldii*	Fernald's Serviceberry				S1	2	32.9 ± 1.0	NB
P	*Crataegus jonesiae*	Jones' Hawthorn				S1	1	55.9 ± 1.0	NB
P	*Dryas integrifolia*	Entire-leaved Mountain Avens				S1	15	42.3 ± 0.0	NB
P	*Potentilla canadensis*	Canada Cinquefoil				S1	1	57.4 ± 0.0	NB
P	*Rubus flagellaris*	Northern Dewberry				S1	3	72.0 ± 0.0	NS
P	*Salix myrtillifolia*	Blueberry Willow				S1	25	43.3 ± 0.0	NB
P	*Saxifraga paniculata ssp. laestadii*	Laestadius' Saxifrage				S1	50	35.1 ± 1.0	NB
P	*Viola sagittata var. ovata*	Arrow-Leaved Violet				S1	1	99.4 ± 2.0	NS
P	*Carex annectens*	Yellow-Fruited Sedge				S1	2	69.4 ± 0.0	NB
P	*Carex atlantica ssp. atlantica*	Atlantic Sedge				S1	8	48.3 ± 0.0	NB
P	*Carex backii*	Rocky Mountain Sedge				S1	3	22.0 ± 0.0	NB
P	*Carex merritt-fernaldii*	Merritt Fernald's Sedge				S1	1	22.0 ± 0.0	NB
P	*Carex scirpoidea*	Scirpuslike Sedge				S1	6	36.3 ± 0.0	NB
P	*Carex sterilis*	Sterile Sedge				S1	1	12.7 ± 2.0	NB
P	*Carex grisea*	Inflated Narrow-leaved Sedge				S1	12	33.5 ± 5.0	NB
P	*Carex saxatilis*	Russet Sedge				S1	12	77.9 ± 10.0	NB
P	*Scirpus pendulus*	Hanging Bulrush				S1	8	5.7 ± 0.0	NB
P	*Sisyrinchium angustifolium*	Narrow-leaved Blue-eyed-grass				S1	1	88.4 ± 5.0	NS
P	*Juncus greenei*	Greene's Rush				S1	2	68.4 ± 10.0	NB

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P	*Juncus stygius ssp. americanus*	Moor Rush				S1	17	68.4 ± 10.0	NB
P	*Juncus subtilis*	Creeping Rush				S1	1	74.3 ± 5.0	NB
P	*Allium canadense*	Canada Garlic				S1	1	69.0 ± 0.0	NB
P	*Goodyera pubescens*	Downy Rattlesnake-Plantain				S1	14	4.4 ± 5.0	NB
P	*Malaxis monophyllos var. brachypoda*	North American White Adder's-mouth				S1	4	20.7 ± 0.0	NB
P	*Platanthera flava var. herbiola*	Pale Green Orchid				S1	1	20.7 ± 0.0	NB
P	*Platanthera macrophylla*	Large Round-Leaved Orchid				S1	12	35.5 ± 1.0	NB
P	*Bromus pubescens*	Hairy Wood Brome Grass				S1	7	74.7 ± 0.0	NB
P	*Calamagrostis stricta ssp. inexpansa*	Slim-stemmed Reed Grass				S1	2	68.5 ± 0.0	NB
P	*Cinna arundinacea*	Sweet Wood Reed Grass				S1	5	59.4 ± 1.0	NB
P	*Danthonia compressa*	Flattened Oat Grass				S1	16	31.4 ± 1.0	NB
P	*Dichanthelium dichotomum*	Forked Panic Grass				S1	1	75.9 ± 1.0	NB
P	*Potamogeton friesii*	Fries' Pondweed				S1	2	65.5 ± 0.0	NB
P	*Potamogeton nodosus*	Long-leaved Pondweed				S1	7	75.8 ± 0.0	NB
P	*Potamogeton strictifolius*	Straight-leaved Pondweed				S1	2	64.1 ± 2.0	NB
P	*Xyris difformis*	Bog Yellow-eyed-grass				S1	3	94.2 ± 0.0	NB
P	*Asplenium ruta-muraria var. cryptolepis*	Wallrue Spleenwort				S1	4	86.4 ± 0.0	NB
P	*Cystopteris laurentiana*	Laurentian Bladder Fern				S1	1	35.5 ± 1.0	NB
P	*Dryopteris filix-mas ssp. brittonii*	Britton's Male Fern				S1	2	28.8 ± 1.0	NB
P	*Huperzia selago*	Northern Firmoss				S1	1	78.2 ± 1.0	NS
P	*Sceptridium oneidense*	Blunt-lobed Moonwort				S1	3	88.4 ± 5.0	NB
P	*Selaginella rupestris*	Rock Spikemoss				S1	9	30.2 ± 1.0	NB
P	*Cuscuta campestris*	Field Dodder				S1?	3	61.8 ± 5.0	NB
P	*Polygonum aviculare ssp. neglectum*	Narrow-leaved Knotweed				S1?	3	70.4 ± 0.0	NB
P	*Alisma subcordatum*	Southern Water Plantain				S1?	1	69.9 ± 0.0	NB
P	*Carex laxiflora*	Loose-Flowered Sedge				S1?	1	78.2 ± 7.0	NS
P	*Wolffia columbiana*	Columbian Watermeal				S1?	1	95.6 ± 0.0	NB
P	*Spiranthes ochroleuca*	Yellow Ladies'-tresses				S1S2	14	33.9 ± 0.0	NB
P	*Eriophorum russeolum ssp. albidum*	Smooth-fruited Russet Cottongrass				S1S3	12	22.2 ± 0.0	NB
P	*Spiranthes cernua*	Nodding Ladies'-Tresses				S1S3	19	39.0 ± 0.0	NB
P	*Spiranthes arcisepala*	Appalachian Ladies'-tresses				S1S3	7	40.9 ± 0.0	NB
P	*Spiranthes incurva*	Sphinx Ladies'-tresses				S1S3	1	27.5 ± 0.0	NB
P	*Neottia bifolia*	Southern Twayblade			Endangered	S2	50	22.4 ± 0.0	NB
P	*Sanicula trifoliata*	Large-Fruited Sanicle				S2	1	65.1 ± 5.0	NB
P	*Hieracium robinsonii*	Robinson's Hawkweed				S2	12	36.2 ± 0.0	NB
P	*Atriplex glabriuscula var. franktonii*	Frankton's Saltbush				S2	5	47.4 ± 1.0	NB
P	*Hypericum x dissimulatum*	Disguised St. John's-wort				S2	1	53.4 ± 1.0	NB
P	*Viburnum dentatum*	Southern Arrow-Wood				S2	2	41.3 ± 0.0	NB
P	*Viburnum dentatum var. lucidum*	Northern Arrow-Wood				S2	1	60.1 ± 0.0	NB
P	*Astragalus eucosmus*	Elegant Milk-vetch				S2	3	75.9 ± 0.0	NB
P	*Quercus macrocarpa*	Bur Oak				S2	101	32.0 ± 0.0	NB
P	*Nuphar x rubrodisca*	Red-disk Yellow Pond-lily				S2	15	39.7 ± 0.0	NB
P	*Polygaloides paucifolia*	Fringed Milkwort				S2	8	30.9 ± 1.0	NB
P	*Persicaria amphibia var. emersa*	Long-root Smartweed				S2	37	52.1 ± 0.0	NB
P	*Anemone parviflora*	Small-flowered Anemone				S2	9	43.3 ± 0.0	NB
P	*Geum fragarioides*	Barren Strawberry				S2	1	66.7 ± 1.0	NB
P	*Scrophularia lanceolata*	Lance-leaved Figwort				S2	4	31.4 ± 1.0	NB

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P	*Carex albicans var. emmonsii*	White-tinged Sedge				S2	14	34.8 ± 0.0	NB
P	*Cyperus lupulinus ssp. macilentus*	Hop Flatsedge				S2	64	62.3 ± 0.0	NB
P	*Galearis rotundifolia*	Small Round-leaved Orchid				S2	3	48.5 ± 0.0	NB
P	*Calypso bulbosa var. americana*	Calypso				S2	8	4.3 ± 5.0	NB
P	*Coeloglossum viride*	Long-bracted Frog Orchid				S2	17	20.7 ± 0.0	NB
P	*Cypripedium parviflorum var. makasin*	Small Yellow Lady's-Slipper				S2	5	33.2 ± 0.0	NB
P	*Platanthera huronensis*	Fragrant Green Orchid				S2	4	37.4 ± 0.0	NB
P	*Festuca subverticillata*	Nodding Fescue				S2	7	70.7 ± 0.0	NS
P	*Puccinellia nutkaensis*	Alaska Alkaligrass				S2	2	68.2 ± 1.0	NB
P	*Diphasiastrum sitchense*	Sitka Ground-cedar				S2	4	49.6 ± 5.0	NB
P	*Schizaea pusilla*	Little Curlygrass Fern				S2	9	37.7 ± 0.0	NB
P	*Coryphopteris simulata*	Bog Fern				S2	29	28.6 ± 0.0	NB
P	*Toxicodendron radicans var. radicans*	Eastern Poison Ivy				S2?	16	50.7 ± 0.0	NB
P	*Symphyotrichum novi-belgii var. crenifolium*	New York Aster				S2?	7	43.3 ± 0.0	NB
P	*Humulus lupulus var. lupuloides*	Common Hop				S2?	2	71.8 ± 5.0	NB
P	*Crataegus macrosperma*	Big-Fruit Hawthorn				S2?	2	42.4 ± 0.0	NB
P	*Rubus x recurvicaulis*	arching dewberry				S2?	6	50.2 ± 1.0	NB
P	*Osmorhiza longistylis*	Smooth Sweet Cicely				S2S3	6	79.5 ± 0.0	NB
P	*Symphyotrichum racemosum*	Small White Aster				S2S3	9	52.3 ± 0.0	NB
P	*Alnus serrulata*	Smooth Alder				S2S3	12	68.5 ± 0.0	NB
P	*Cuscuta cephalanthi*	Buttonbush Dodder				S2S3	6	60.5 ± 0.0	NB
P	*Gentiana linearis*	Narrow-Leaved Gentian				S2S3	1	63.9 ± 50.0	NB
P	*Hedeoma pulegioides*	American False Pennyroyal				S2S3	9	31.6 ± 0.0	NB
P	*Aphyllon uniflorum*	One-flowered Broomrape				S2S3	6	75.4 ± 1.0	NB
P	*Persicaria careyi*	Carey's Smartweed				S2S3	13	50.5 ± 0.0	NB
P	*Hepatica americana*	Round-lobed Hepatica				S2S3	1	47.7 ± 1.0	NB
P	*Cephalanthus occidentalis*	Common Buttonbush				S2S3	21	69.9 ± 0.0	NB
P	*Galium obtusum*	Blunt-leaved Bedstraw				S2S3	10	55.2 ± 10.0	NB
P	*Euphrasia randii*	Rand's Eyebright				S2S3	7	46.5 ± 0.0	NB
P	*Dirca palustris*	Eastern Leatherwood				S2S3	2	41.7 ± 1.0	NB
P	*Viola novae-angliae*	New England Violet				S2S3	3	75.6 ± 0.0	NB
P	*Carex comosa*	Bearded Sedge				S2S3	7	74.2 ± 1.0	NS
P	*Carex rostrata*	Narrow-leaved Beaked Sedge				S2S3	3	31.9 ± 0.0	NB
P	*Carex vacillans*	Estuarine Sedge				S2S3	4	73.5 ± 0.0	NB
P	*Allium tricoccum*	Wild Leek				S2S3	23	3.6 ± 5.0	NB
P	*Corallorhiza maculata var. occidentalis*	Spotted Coralroot				S2S3	13	23.0 ± 1.0	NB
P	*Corallorhiza maculata var. maculata*	Spotted Coralroot				S2S3	4	26.2 ± 0.0	NB
P	*Elymus canadensis*	Canada Wild Rye				S2S3	2	30.0 ± 1.0	NB
P	*Piptatheropsis canadensis*	Canada Ricegrass				S2S3	4	3.6 ± 10.0	NB
P	*Puccinellia phryganodes ssp. neoarctica*	Creeping Alkali Grass				S2S3	2	48.7 ± 0.0	NB
P	*Poa glauca*	Glaucous Blue Grass				S2S3	23	39.7 ± 0.0	NB
P	*Piptatheropsis pungens*	Slender Ricegrass				S2S3	5	22.0 ± 0.0	NB
P	*Panax trifolius*	Dwarf Ginseng				S3	37	29.6 ± 0.0	NB
P	*Artemisia campestris ssp. caudata*	Tall Wormwood				S3	143	46.0 ± 10.0	NB
P	*Artemisia campestris*	Field Wormwood				S3	4	46.5 ± 0.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
P	*Nabalus racemosus*	Glaucous Rattlesnakeroot				S3	57	52.8 ± 0.0	NB
P	*Tanacetum bipinnatum ssp. huronense*	Lake Huron Tansy				S3	14	68.3 ± 1.0	NB
P	*Ionactis linariifolia*	Flax-leaved Aster				S3	44	90.1 ± 0.0	NB
P	*Pseudognaphalium macounii*	Macoun's Cudweed				S3	4	4.4 ± 5.0	NB
P	*Impatiens pallida*	Pale Jewelweed				S3	9	36.0 ± 0.0	NB
P	*Boechera stricta*	Drummond's Rockcress				S3	19	22.1 ± 0.0	NB
P	*Turritis glabra*	Tower Mustard				S3	1	49.9 ± 0.0	NB
P	*Arabis pycnocarpa*	Cream-flowered Rockcress				S3	15	22.1 ± 1.0	NB
P	*Cardamine maxima*	Large Toothwort				S3	38	49.9 ± 0.0	NB
P	*Stellaria humifusa*	Saltmarsh Starwort				S3	14	43.2 ± 0.0	NB
P	*Stellaria longifolia*	Long-leaved Starwort				S3	11	46.1 ± 0.0	NB
P	*Oxybasis rubra*	Red Goosefoot				S3	12	67.6 ± 0.0	NB
P	*Hudsonia tomentosa*	Woolly Beach-heath				S3	322	68.6 ± 50.0	NB
P	*Cornus obliqua*	Silky Dogwood				S3	89	36.5 ± 0.0	NB
P	*Triosteum aurantiacum*	Orange-fruited Tinker's Weed				S3	7	5.1 ± 0.0	NB
P	*Viburnum lentago*	Nannyberry				S3	1	36.3 ± 0.0	NB
P	*Rhodiola rosea*	Roseroot				S3	100	36.0 ± 0.0	NB
P	*Shepherdia canadensis*	Soapberry				S3	42	42.2 ± 0.0	NB
P	*Oxytropis campestris var. johannensis*	Field Locoweed				S3	28	60.4 ± 0.0	NB
P	*Bartonia paniculata*	Branched Bartonia				S3	2	48.8 ± 0.0	NB
P	*Bartonia paniculata ssp. iodandra*	Branched Bartonia				S3	22	33.5 ± 0.0	NB
P	*Geranium bicknellii*	Bicknell's Crane's-bill				S3	26	4.4 ± 5.0	NB
P	*Myriophyllum farwellii*	Farwell's Water Milfoil				S3	12	32.7 ± 0.0	NB
P	*Myriophyllum humile*	Low Water Milfoil				S3	2	31.7 ± 1.0	NB
P	*Myriophyllum quitense*	Andean Water Milfoil				S3	67	64.1 ± 0.0	NB
P	*Proserpinaca palustris*	Marsh Mermaidweed				S3	4	53.5 ± 0.0	NB
P	*Utricularia resupinata*	Inverted Bladderwort				S3	4	84.5 ± 1.0	NB
P	*Fraxinus pennsylvanica*	Red Ash				S3	113	40.5 ± 0.0	NB
P	*Rumex pallidus*	Seabeach Dock				S3	5	62.4 ± 0.0	NS
P	*Primula mistassinica*	Mistassini Primrose				S3	7	75.5 ± 0.0	NB
P	*Pyrola minor*	Lesser Pyrola				S3	5	35.1 ± 1.0	NB
P	*Clematis occidentalis*	Purple Clematis				S3	19	21.9 ± 0.0	NB
P	*Ranunculus flabellaris*	Yellow Water Buttercup				S3	15	15.3 ± 0.0	NB
P	*Amelanchier canadensis*	Canada Serviceberry				S3	15	30.1 ± 1.0	NB
P	*Crataegus scabrida*	Rough Hawthorn				S3	10	28.3 ± 1.0	NB
P	*Rubus occidentalis*	Black Raspberry				S3	5	51.8 ± 0.0	NB
P	*Salix myricoides*	Bayberry Willow				S3	2	43.8 ± 1.0	NB
P	*Salix nigra*	Black Willow				S3	166	32.1 ± 0.0	NB
P	*Salix interior*	Sandbar Willow				S3	13	35.9 ± 1.0	NB
P	*Comandra umbellata*	Bastard's Toadflax				S3	38	63.6 ± 0.0	NB
P	*Agalinis purpurea var. parviflora*	Small-flowered Purple False Foxglove				S3	25	61.0 ± 0.0	NB
P	*Viola adunca*	Hooked Violet				S3	7	22.0 ± 0.0	NB
P	*Sagittaria montevidensis ssp. spongiosa*	Spongy Arrowhead				S3	68	63.3 ± 0.0	NB
P	*Symplocarpus foetidus*	Eastern Skunk Cabbage				S3	142	72.1 ± 5.0	NB
P	*Carex adusta*	Lesser Brown Sedge				S3	14	38.3 ± 10.0	NB
P	*Carex arcta*	Northern Clustered Sedge				S3	52	3.5 ± 5.0	NB
P	*Carex conoidea*	Field Sedge				S3	18	21.3 ± 1.0	NB
P	*Carex garberi*	Garber's Sedge				S3	2	67.4 ± 0.0	NB
P	*Carex granularis*	Limestone Meadow Sedge				S3	5	32.6 ± 5.0	NB
P	*Carex gynocrates*	Northern Bog Sedge				S3	1	31.4 ± 1.0	NB
P	*Carex hirtifolia*	Pubescent Sedge				S3	5	3.5 ± 5.0	NB
P	*Carex livida*	Livid Sedge				S3	10	82.5 ± 0.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
P	*Carex ormostachya*	Necklace Spike Sedge				S3	7	14.5 ± 1.0	NB
P	*Carex plantaginea*	Plantain-Leaved Sedge				S3	3	46.4 ± 0.0	NB
P	*Carex rosea*	Rosy Sedge				S3	30	30.4 ± 0.0	NB
P	*Carex sprengelii*	Longbeak Sedge				S3	2	36.9 ± 0.0	NB
P	*Carex tenuiflora*	Sparse-Flowered Sedge				S3	3	2.9 ± 10.0	NB
P	*Cyperus esculentus var. leptostachyus*	Perennial Yellow Nutsedge				S3	71	7.4 ± 0.0	NB
P	*Cyperus squarrosus*	Awned Flatsedge				S3	44	57.9 ± 0.0	NB
P	*Eriophorum gracile*	Slender Cottongrass				S3	46	63.2 ± 0.0	NB
P	*Blysmopsis rufa*	Red Bulrush				S3	27	90.2 ± 0.0	NB
P	*Elodea nuttallii*	Nuttall's Waterweed				S3	4	74.9 ± 0.0	NB
P	*Juncus vaseyi*	Vasey Rush				S3	10	20.1 ± 0.0	NB
P	*Najas gracillima*	Thread-Like Naiad				S3	3	79.9 ± 0.0	NB
P	*Cypripedium reginae*	Showy Lady's-Slipper				S3	10	12.6 ± 0.0	NB
P	*Neottia auriculata*	Auricled Twayblade				S3	1	39.4 ± 0.0	NB
P	*Platanthera grandiflora*	Large Purple Fringed Orchid				S3	44	12.2 ± 1.0	NB
P	*Platanthera orbiculata*	Small Round-leaved Orchid				S3	16	31.4 ± 0.0	NB
P	*Spiranthes lucida*	Shining Ladies'-Tresses				S3	9	3.6 ± 1.0	NB
P	*Bromus latiglumis*	Broad-Glumed Brome				S3	25	4.2 ± 0.0	NB
P	*Dichanthelium linearifolium*	Narrow-leaved Panic Grass				S3	1	42.4 ± 0.0	NB
P	*Leersia virginica*	White Cut Grass				S3	31	71.0 ± 0.0	NB
P	*Schizachyrium scoparium*	Little Bluestem				S3	40	53.1 ± 0.0	NB
P	*Zizania aquatica*	Southern Wild Rice				S3	1	72.5 ± 0.0	NB
P	*Zizania aquatica var. aquatica*	Eastern Wild Rice				S3	5	47.3 ± 1.0	NB
P	*Adiantum pedatum*	Northern Maidenhair Fern				S3	1	47.7 ± 1.0	NB
P	*Asplenium trichomanes*	Maidenhair Spleenwort				S3	15	22.1 ± 1.0	NB
P	*Anchistea virginica*	Virginia chain fern				S3	20	68.5 ± 0.0	NB
P	*Woodsia alpina*	Alpine Cliff Fern				S3	11	35.6 ± 0.0	NB
P	*Woodsia glabella*	Smooth Cliff Fern				S3	68	33.2 ± 0.0	NB
P	*Isoetes tuckermanii ssp. tuckermanii*	Tuckerman's Quillwort				S3	5	33.5 ± 0.0	NB
P	*Diphasiastrum x sabinifolium*	Savin-leaved Ground-cedar				S3	19	34.6 ± 0.0	NB
P	*Huperzia appressa*	Mountain Firmoss				S3	49	39.2 ± 0.0	NB
P	*Sceptridium dissectum*	Dissected Moonwort				S3	18	42.7 ± 1.0	NB
P	*Botrychium lanceolatum ssp. angustisegmentum*	Narrow Triangle Moonwort				S3	17	26.5 ± 5.0	NB
P	*Botrychium simplex*	Least Moonwort				S3	6	39.6 ± 0.0	NB
P	*Ophioglossum pusillum*	Northern Adder's-tongue				S3	5	29.5 ± 5.0	NB
P	*Selaginella selaginoides*	Low Spikemoss				S3	8	38.8 ± 5.0	NB
P	*Crataegus submollis*	Quebec Hawthorn				S3?	7	59.3 ± 1.0	NB
P	*Platanthera hookeri*	Hooker's Orchid				S3?	25	4.3 ± 2.0	NB
P	*Bidens hyperborea*	Estuary Beggarticks				S3S4	31	55.1 ± 1.0	NB
P	*Solidago altissima*	Tall Goldenrod				S3S4	5	50.6 ± 0.0	NB
P	*Symphyotrichum boreale*	Boreal Aster				S3S4	9	12.5 ± 0.0	NB
P	*Betula pumila*	Bog Birch				S3S4	70	21.9 ± 0.0	NB
P	*Mertensia maritima*	Sea Lungwort				S3S4	17	46.3 ± 0.0	NB
P	*Subularia aquatica ssp. americana*	American Water Awlwort				S3S4	2	31.3 ± 0.0	NB
P	*Callitriche hermaphroditica*	Northern Water-starwort				S3S4	9	32.1 ± 0.0	NB
P	*Viburnum edule*	Squashberry				S3S4	15	33.8 ± 0.0	NB
P	*Crassula aquatica*	Water Pygmyweed				S3S4	8	64.2 ± 0.0	NB
P	*Penthorum sedoides*	Ditch Stonecrop				S3S4	72	4.5 ± 0.0	NB
P	*Elatine americana*	American Waterwort				S3S4	11	64.0 ± 0.0	NB
P	*Hedysarum americanum*	Alpine Hedysarum				S3S4	2	75.9 ± 0.0	NB
P	*Fagus grandifolia*	American Beech				S3S4	172	11.4 ± 1.0	NB
P	*Geranium robertianum*	Herb Robert				S3S4	51	23.0 ± 0.0	NB
P	*Stachys hispida*	Smooth Hedge-Nettle				S3S4	4	70.2 ± 0.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
P	*Stachys pilosa*	Hairy Hedge-Nettle				S3S4	6	66.1 ± 1.0	NB
P	*Teucrium canadense*	Canada Germander				S3S4	63	60.8 ± 0.0	NB
P	*Utricularia gibba*	Humped Bladderwort				S3S4	8	74.1 ± 0.0	NB
P	*Fraxinus americana*	White Ash				S3S4	168	11.4 ± 1.0	NB
P	*Epilobium strictum*	Downy Willowherb				S3S4	28	11.0 ± 0.0	NB
P	*Fallopia scandens*	Climbing False Buckwheat				S3S4	75	4.5 ± 0.0	NB
P	*Rumex persicarioides*	Peach-leaved Dock				S3S4	2	34.6 ± 1.0	NB
P	*Littorella americana*	American Shoreweed				S3S4	6	61.8 ± 1.0	NB
P	*Samolus parviflorus*	Seaside Brookweed				S3S4	98	57.2 ± 0.0	NB
P	*Thalictrum confine*	Northern Meadow-rue				S3S4	69	61.5 ± 0.0	NB
P	*Drymocallis arguta*	Tall Wood Beauty				S3S4	2	76.5 ± 0.0	NB
P	*Rosa palustris*	Swamp Rose				S3S4	16	31.9 ± 5.0	NB
P	*Rubus pensilvanicus*	Pennsylvania Blackberry				S3S4	29	10.7 ± 0.0	NB
P	*Sanguisorba canadensis*	Canada Burnet				S3S4	20	40.4 ± 0.0	NB
P	*Galium boreale*	Northern Bedstraw				S3S4	7	45.3 ± 0.0	NB
P	*Galium labradoricum*	Labrador Bedstraw				S3S4	2	12.3 ± 0.0	NB
P	*Salix pedicellaris*	Bog Willow				S3S4	77	4.4 ± 5.0	NB
P	*Geocaulon lividum*	Northern Comandra				S3S4	35	47.9 ± 0.0	NB
P	*Agalinis neoscotica*	Nova Scotia Agalinis				S3S4	1	79.1 ± 0.0	NS
P	*Limosella australis*	Southern Mudwort				S3S4	53	55.6 ± 0.0	NB
P	*Ulmus americana*	White Elm				S3S4	149	4.4 ± 0.0	NB
P	*Boehmeria cylindrica*	Small-spike False-nettle				S3S4	4	80.0 ± 0.0	NB
P	*Juniperus horizontalis*	Creeping Juniper				S3S4	8	32.1 ± 1.0	NB
P	*Carex capillaris*	Hairlike Sedge				S3S4	23	38.9 ± 0.0	NB
P	*Carex eburnea*	Bristle-leaved Sedge				S3S4	20	29.1 ± 100.0	NB
P	*Carex exilis*	Coastal Sedge				S3S4	32	48.4 ± 0.0	NB
P	*Carex haydenii*	Hayden's Sedge				S3S4	72	35.7 ± 0.0	NB
P	*Carex lupulina*	Hop Sedge				S3S4	83	5.0 ± 0.0	NB
P	*Carex tenera*	Tender Sedge				S3S4	48	4.4 ± 0.0	NB
P	*Carex wiegandii*	Wiegand's Sedge				S3S4	168	3.7 ± 10.0	NB
P	*Carex recta*	Estuary Sedge				S3S4	13	43.6 ± 0.0	NB
P	*Carex atratiformis*	Scabrous Black Sedge				S3S4	3	93.8 ± 0.0	NS
P	*Cladium mariscoides*	Smooth Twigrush				S3S4	7	73.8 ± 0.0	NB
P	*Cyperus dentatus*	Toothed Flatsedge				S3S4	192	52.2 ± 0.0	NB
P	*Eleocharis quinqueflora*	Few-flowered Spikerush				S3S4	6	87.0 ± 0.0	NB
P	*Rhynchospora capitellata*	Small-headed Beakrush				S3S4	2	48.7 ± 0.0	NB
P	*Trichophorum clintonii*	Clinton's Clubrush				S3S4	27	39.1 ± 0.0	NB
P	*Bolboschoenus fluviatilis*	River Bulrush				S3S4	55	49.5 ± 0.0	NB
P	*Triglochin gaspensis*	Gasp├⌐ Arrowgrass				S3S4	52	46.5 ± 0.0	NB
P	*Lilium canadense*	Canada Lily				S3S4	78	4.2 ± 0.0	NB
P	*Triantha glutinosa*	Sticky False-Asphodel				S3S4	3	76.3 ± 0.0	NB
P	*Corallorhiza maculata*	Spotted Coralroot				S3S4	29	18.9 ± 0.0	NB
P	*Liparis loeselii*	Loesel's Twayblade				S3S4	16	9.6 ± 1.0	NB
P	*Neottia cordata*	Heart-leaved Twayblade				S3S4	13	12.6 ± 1.0	NB
P	*Platanthera obtusata*	Blunt-leaved Orchid				S3S4	18	5.1 ± 2.0	NB
P	*Calamagrostis pickeringii*	Pickering's Reed Grass				S3S4	34	18.0 ± 0.0	NB
P	*Calamagrostis stricta*	Slim-stemmed Reed Grass				S3S4	21	32.1 ± 0.0	NB
P	*Calamagrostis stricta ssp. stricta*	Slim-stemmed Reed Grass				S3S4	13	72.4 ± 0.0	NB
P	*Eragrostis pectinacea*	Tufted Love Grass				S3S4	7	9.9 ± 0.0	NB
P	*Stuckenia filiformis*	Thread-leaved Pondweed				S3S4	6	68.4 ± 1.0	NB
P	*Potamogeton praelongus*	White-stemmed Pondweed				S3S4	12	67.7 ± 0.0	NB
P	*Potamogeton richardsonii*	Richardson's Pondweed				S3S4	33	61.9 ± 0.0	NB
P	*Xyris montana*	Northern Yellow-Eyed-Grass				S3S4	143	21.7 ± 0.0	NB
P	*Cryptogramma stelleri*	Steller's Rockbrake				S3S4	2	62.5 ± 0.0	NB
P	*Asplenium viride*	Green Spleenwort				S3S4	22	22.1 ± 1.0	NB
P	*Dryopteris fragrans*	Fragrant Wood Fern				S3S4	79	35.6 ± 0.0	NB
P	*Equisetum palustre*	Marsh Horsetail				S3S4	3	80.1 ± 0.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
P	*Polypodium appalachianum*	Appalachian Polypody				S3S4	30	18.2 ± 0.0	NB
P	*Montia fontana*	Water Blinks				SH	3	61.7 ± 1.0	NB
P	*Brachyelytrum erectum*	Bearded Shorthusk				SH	2	69.4 ± 2.0	NB
P	*Solidago caesia*	Blue-stemmed Goldenrod				SX	2	98.6 ± 1.0	NB
P	*Agalinis maritima*	Saltmarsh Agalinis				SX	2	91.0 ± 50.0	NB
P	*Carex swanii*	Swan's Sedge				SX	1	95.8 ± 2.0	NS

5.1 SOURCE BIBLIOGRAPHY (100 km)

The recipient of these data shall acknowledge the AC CDC and the data sources listed below in any documents, reports, publications or presentations, in which this dataset makes a significant contribution.

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315	Clayden, S.R. 1998. NBM Science Collections databases: vascular plants. New Brunswick Museum, Saint John NB, 19759 recs.
283	Belliveau, A.G. 2020. E.C. Smith Herbarium and Atlantic Canada Conservation Data Centre Fieldwork 2019, 2020. E.C. Smith Herbarium.
282	Belland, R.J. Maritimes moss records from various herbarium databases. 2014.
258	Blaney, C.S.; Mazerolle, D.M.; Belliveau, A.B. 2013. Atlantic Canada Conservation Data Centre Fieldwork 2013. Atlantic Canada Conservation Data Centre, 9000+ recs.
253	Benedict, B. Connell Herbarium Specimens (Data) . University New Brunswick, Fredericton. 2003.
250	Blaney, C.S. 2020. Sean Blaney 2020 field data. Atlantic Canada Conservation Data Centre, 4407 records.
235	Tims, J. & Craig, N. 1995. Environmentally Significant Areas in New Brunswick (NBESA). NB Dept of Environment & Nature Trust of New Brunswick Inc, 6042 recs. https://doi.org/10.1037/arc0000014.
210	Sollows, M.C,. 2009. NBM Science Collections databases: molluscs. New Brunswick Museum, Saint John NB, download Jan. 2009, 6951 recs (2957 in Atlantic Canada).
202	Klymko, J. 2020. Atlantic Canada Conservation Data Centre zoological fieldwork 2019. Atlantic Canada Conservation Data Centre.
198	Churchill, J.L.; Klymko, J.D. 2016. Bird Species at Risk Inventory on the Acadia Research Forest, 2016. Atlantic Canada Conservation Data Centre, 1043 recs.
187	Porter, Caitlin. 2021. Field data for 2020 in various locations across the Maritimes. Atlantic Canada Conservation Data Centre, 3977 records.
183	Sollows, M.C,. 2008. NBM Science Collections databases: mammals. New Brunswick Museum, Saint John NB, download Jan. 2008, 4983 recs.
182	Mazerolle, D.M. 2017. Atlantic Canada Conservation Data Centre Fieldwork 2017. Atlantic Canada Conservation Data Centre.
179	Klymko, J. 2019. Atlantic Canada Conservation Data Centre zoological fieldwork 2018. Atlantic Canada Conservation Data Centre.
169	Amirault, D.L. & Stewart, J. 2007. Piping Plover Database 1894-2006. Canadian Wildlife Service, Sackville, 3344 recs, 1228 new.
163	Parks Canada. 2010. Specimens in or near National Parks in Atlantic Canada. Canadian National Museum, 3925 recs.
163	Wallace, S. 2020. Stewardship Department species occurrence data on NTNB preserves. Nature Trust of New Brunswick.
162	Epworth, W. 2012. Species at Risk records, 2009-11. Fort Folly Habitat Recovery Program, 162 recs.
156	Blaney, C.S.; Mazerolle, D.M. 2010. Fieldwork 2010. Atlantic Canada Conservation Data Centre. Sackville NB, 15508 recs.

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147	Stewart, J.I. 2010. Peregrine Falcon Surveys in New Brunswick, 2002-09. Canadian Wildlife Service, Sackville, 58 recs.
146	Beaudet, A. 2007. Piping Plover Records in Kouchibouguac NP, 1982-2005. Kouchibouguac National Park, 435 recs.
145	Bagnell, B.A. 2001. New Brunswick Bryophyte Occurrences. B&B Botanical, Sussex, 478 recs.
144	Belliveau, A.G. 2018. Atlantic Canada Conservation Data Centre Fieldwork 2017. Atlantic Canada Conservation Data Centre.
144	Klymko, J. 2018. Maritimes Butterfly Atlas database. Atlantic Canada Conservation Data Centre.
138	iNaturalist. 2018. iNaturalist Data Export 2018. iNaturalist.org and iNaturalist.ca, Web site: 11700 recs.
136	Clayden, S.R. 2007. NBM Science Collections databases: vascular plants. New Brunswick Museum, Saint John NB, download Mar. 2007, 6914 recs.
135	Churchill, J.L.; Klymko, J.D. 2015. Chignecto and Tintamarre National Wildlife Area Bird Surveys 2015. Atlantic Canada Conservation Data Centre, 2238 recs.
135	McAlpine, D.F. 1998. NBM Science Collections databases to 1998. New Brunswick Museum, Saint John NB, 241 recs.
134	Churchill, J.L. 2018. Atlantic Canada Conservation Data Centre Fieldwork 2018. Atlantic Canada Conservation Data Centre, 907 recs.
129	Mazerolle, D.M. 2020. Atlantic Canada Conservation Data Centre botanical fieldwork 2019. Atlantic Canada Conservation Data Centre.
127	Bishop, G. & Papoulias, M.; Arnold (Chaplin), M. 2005. Grand Lake Meadows field notes, Summer 2005. New Brunswick Federation of Naturalists, 1638 recs.
123	Blaney, C.S. 2017. Atlantic Canada Conservation Data Centre Fieldwork 2017. Atlantic Canada Conservation Data Centre.
122	Wilhelm, S.I. et al. 2011. Colonial Waterbird Database. Canadian Wildlife Service, Sackville, 2698 sites, 9718 recs (8192 obs).
120	Blaney, C.S. & Mazerolle, D.M. 2011. Field data from NCC properties at Musquash Harbour NB & Goose Lake NS. Atlantic Canada Conservation Data Centre, 1739 recs.
113	Mazerolle, D.M. 2018. Atlantic Canada Conservation Data Centre botanical fieldwork 2018. Atlantic Canada Conservation Data Centre, 13515 recs.
112	Churchill, J.L. 2018. Atlantic Canada Conservation Data Centre Fieldwork 2017. Atlantic Canada Conservation Data Centre, 2318 recs.
105	Newell, R.E. 2000. E.C. Smith Herbarium Database. Acadia University, Wolfville NS, 7139 recs.
102	Clayden, S. Digitization of Wolfgang Maass Nova Scotia forest lichen collections, 1964-2004. New Brunswick Museum. 2018.
100	Blaney, C.S.; Mazerolle, D.M.; Belliveau, A.B. 2014. Atlantic Canada Conservation Data Centre Fieldwork 2014. Atlantic Canada Conservation Data Centre, # recs.
98	Mazerolle, D.M. 2016. Atlantic Canada Conservation Data Centre Fieldwork 2017. Atlantic Canada Conservation Data Centre.
93	Hinds, H.R. 1986. Notes on New Brunswick plant collections. Connell Memorial Herbarium, unpubl, 739 recs.
91	Erskine, A.J. 1999. Maritime Nest Records Scheme (MNRS) 1937-1999. Canadian Wildlife Service, Sackville, 313 recs.
86	Scott, Fred W. 1998. Updated Status Report on the Cougar (Puma Concolor couguar) [Eastern population]. Committee on the Status of Endangered Wildlife in Canada, 298 recs.
85	Blaney, C.S. 2000. Fieldwork 2000. Atlantic Canada Conservation Data Centre. Sackville NB, 1265 recs.
83	Blaney, C.S.; Spicer, C.D.; Mazerolle, D.M. 2005. Fieldwork 2005. Atlantic Canada Conservation Data Centre. Sackville NB, 2333 recs.
81	Richardson, Leif. 2018. Maritimes Bombus records from various sources. Richardson, Leif.
75	Sabine, D.L. 2005. 2001 Freshwater Mussel Surveys. New Brunswick Dept of Natural Resources & Energy, 590 recs.
73	Klymko, J.J.D. 2016. 2015 field data. Atlantic Canada Conservation Data Centre.
72	Honeyman, K. 2019. Unique Areas Database, 2018. J.D. Irving Ltd.
72	iNaturalist. 2020. iNaturalist butterfly records selected for the Maritimes Butterfly Atlas. iNaturalist.
71	Churchill, J.L.; Walker, J. 2017. Species at Risk Surveys at Correctional Services Canada Properties in Nova Scotia and New Brunswick. Atlantic Canada Conservation Data Centre.
70	Belliveau, A.G. 2018. E.C. Smith Herbarium and Atlantic Canada Conservation Data Centre Fieldwork 2018. E.C. Smith Herbarium, 6226 recs.
70	Blaney, C.S.; Mazerolle, D.M.; Oberndorfer, E. 2007. Fieldwork 2007. Atlantic Canada Conservation Data Centre. Sackville NB, 13770 recs.
70	Sollows, M.C. 2008. NBM Science Collections databases: herpetiles. New Brunswick Museum, Saint John NB, download Jan. 2008, 8636 recs.
68	Benedict, B. Connell Herbarium Specimen Database Download 2004. Connell Memorial Herbarium, University of New Brunswick. 2004.
67	Klymko, J. 2016. Atlantic Canada Conservation Data Centre Fieldwork 2016. Atlantic Canada Conservation Data Centre.
65	Blaney, C.S.; Spicer, C.D.; Popma, T.M.; Hanel, C. 2002. Fieldwork 2002. Atlantic Canada Conservation Data Centre. Sackville NB, 2252 recs.
64	Belliveau, A.G., Churchill, J.L. 2019. Compilation of flora and fauna observation records from Isle Haute, Nova Scotia. Acadia University; Atlantic Canada Conservation Data Centre, 522 recs.
62	Mazerolle, D.M. 2005. Bouctouche Irving Eco-Centre rare coastal plant fieldwork results 2004-05. Irving Eco-centre, la Dune du Bouctouche, 174 recs.
60	Blaney, C.S. 2016. Atlantic Canada Conservation Data Centre Fieldwork 2016. Atlantic Canada Conservation Data Centre, 6719 recs.
59	Benjamin, L.K. (compiler). 2012. Significant Habitat & Species Database. Nova Scotia Dept Natural Resources, 4965 recs.
57	Brunelle, P.-M. (compiler). 2009. ADIP/MDDS Odonata Database: data to 2006 inclusive. Atlantic Dragonfly Inventory Program (ADIP), 24200 recs.
57	e-Butterfly. 2016. Export of Maritimes records and photos. Maxim Larrivee, Sambo Zhang (ed.) e-butterfly.org.
54	Robinson, S.L. 2015. 2014 field data.
52	Hicks, Andrew. 2009. Coastal Waterfowl Surveys Database, 2000-08. Canadian Wildlife Service, Sackville, 46488 recs (11149 non-zero).
52	Nussey, Pat & NCC staff. 2019. AEI tracked species records, 2016-2019. Chapman, C.J. (ed.) Atlantic Canada Conservation Data Centre, 333.
52	Paquet, Julie. 2019. Atlantic Canada Shorebird Survey ACSS database for 2019. Environment Canada, Canadian Wildlife Service.
50	Benjamin, L.K. (compiler). 2007. Significant Habitat & Species Database. Nova Scotia Dept Natural Resources, 8439 recs.
46	MacDonald, E.C. 2018. Piping Plover nest records from 2010-2017. Canadian Wildlife Service.
46	NatureServe Canada. 2019. iNaturalist Maritimes Butterfly Records. iNaturalist.org and iNaturalist.ca.
45	Blaney, C.S.; Mazerolle, D.M.; Klymko, J; Spicer, C.D. 2006. Fieldwork 2006. Atlantic Canada Conservation Data Centre. Sackville NB, 8399 recs.
44	Blaney, C.S. 2019. Sean Blaney 2019 field data. Atlantic Canada Conservation Data Centre, 4407 records.
43	Nature Trust of New Brunswick. 2021. Nature Trust of New Brunswick site inventory data submitted in April 2021. Nature Trust of New Brunswick, 2189 records.
42	Klymko, J.J.D.; Robinson, S.L. 2014. 2013 field data. Atlantic Canada Conservation Data Centre.
41	Wissink, R. 2006. Fundy National Park Digital Database. Parks Canada, 41 recs.
40	Blaney, C.S.; Mazerolle, D.M. 2011. Fieldwork 2011. Atlantic Canada Conservation Data Centre. Sackville NB.
40	Tremblay, E. 2006. Kouchibouguac National Park Digital Database. Parks Canada, 105 recs.
39	Goltz, J.P. 2012. Field Notes, 1989-2005. , 1091 recs.

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38	Thomas, P. 2018. CSC Dorchester Bobolink Survey. Environment Canada, Canadian Wildlife Service.
36	Amirault, D.L. & McKnight, J. 2003. Piping Plover Database 1991-2003. Canadian Wildlife Service, Sackville, unpublished data. 7 recs.
36	MacDonald, E.C. 2018. CWS Piping Plover Census, 2010-2017. Canadian Wildlife Service, 672 recs.
35	Majka, C. 2009. Université de Moncton Insect Collection: Carabidae, Cerambycidae, Coccinellidae. Université de Moncton, 540 recs.
35	McAlpine, D.F. 1998. NBM Science Collections: Wood Turtle records. New Brunswick Museum, Saint John NB, 329 recs.
34	Robinson, S.L. 2010. Fieldwork 2009 (dune ecology). Atlantic Canada Conservation Data Centre. Sackville NB, 408 recs.
33	Belliveau, A.G. 2016. Atlantic Canada Conservation Data Centre Fieldwork 2016. Atlantic Canada Conservation Data Centre, 10695 recs.
32	Manthorne, A. 2014. MaritimesSwiftwatch Project database 2013-2014. Bird Studies Canada, Sackville NB, 326 recs.
31	Jobin, C. & Clow, A., Van Dijk, J. 2019. Eastern Waterfan data, Mount Allison Fundy Field Camp 2019. Chapman, C.J. (ed.) Fundy National Park and Mount Allison University, 31 recs.
30	Cowie, F. 2007. Electrofishing Population Estimates 1979-98. Canadian Rivers Institute, 2698 recs.
30	Newell, R.E. 2005. E.C. Smith Digital Herbarium. E.C. Smith Herbarium, Irving Biodiversity Collection, Acadia University, Web site: http://luxor.acadiau.ca/library/Herbarium/project/. 582 recs.
30	Pronych, G. & Wilson, A. 1993. Atlas of Rare Vascular Plants in Nova Scotia. Nova Scotia Museum, Halifax NS, I:1-168, II:169-331. 1446 recs.
29	Churchill, J.L., Klymko, J.D.D. 2016. Atlantic Canada Conservation Data Centre Fieldwork 2016. Atlantic Canada Conservation Data Centre.
29	Klymko, J. 2021. Atlantic Canada Conservation Data Centre zoological fieldwork 2020. Atlantic Canada Conservation Data Centre.
28	Spicer, C.D. & Harries, H. 2001. Mount Allison Herbarium Specimens. Mount Allison University, 128 recs.
27	Blaney, C.S. 2018. Atlantic Canada Conservation Data Centre Fieldwork 2018. Atlantic Canada Conservation Data Centre.
27	Munro, Marian K. Nova Scotia Provincial Museum of Natural History Herbarium Database. Nova Scotia Provincial Museum of Natural History, Halifax, Nova Scotia. 2013.
26	Hinds, H.R. 1999. Connell Herbarium Database. University New Brunswick, Fredericton, 131 recs.
25	Canadian Wildlife Service, Dartmouth. 2010. Piping Plover censuses 2007-09, 304 recs.
24	Beardmore, T. 2017. 2017 Butternut observations. Natural Resources Canada.
24	Spicer, C.D. 2002. Fieldwork 2002. Atlantic Canada Conservation Data Centre. Sackville NB, 211 recs.
23	Donell, R. 2008. Rare plant records from rare coastal plant project. Bouctouche Dune Irving Eco-centre. Pers. comm. to D.M. Mazerolle, 50 recs.
23	Epworth, W. 2013. Species at Risk records, 2013. Fort Folly Habitat Recovery Program, 27 recs.
23	Pike, E., Tingley, S. & Christie, D.S. 2000. Nature NB Listserve. University of New Brunswick, listserv.unb.ca/archives/naturenb. 68 recs.
22	Chiasson, R. 2018. Breeding bird observations from NBWTF project. pers. comm. to S. Blaney.
22	Coursol, F. 2005. Dataset from New Brunswick fieldwork for Eriocaulon parkeri COSEWIC report. Coursol, Pers. comm. to C.S. Blaney, Aug 26. 110 recs.
21	Kennedy, Joseph. 2010. New Brunswick Peregrine records, 2009. New Brunswick Dept Natural Resources, 19 recs (14 active).
21	Tingley, S. (compiler). 2001. Butterflies of New Brunswick. , Web site: www.geocities.com/Yosemite/8425/buttrfly. 142 recs.
21	Wood Turtle (Glyptemys insculpta) Miramichi Watershed Synopsis 2013 Compiled by: Vladimir King Trajkovic, EPt Miramichi River Environmental Assessment Committee
20	Blaney, C.S. 2003. Fieldwork 2003. Atlantic Canada Conservation Data Centre. Sackville NB, 1042 recs.
20	Sollows, M.C,. 2009. NBM Science Collections databases: Coccinellid & Cerambycid Beetles. New Brunswick Museum, Saint John NB, download Feb. 2009, 569 recs.
20	Webster, R.P. 2004. Lepidopteran Records for National Wildlife Areas in New Brunswick. Webster, 1101 recs.
19	Godbout, V. 2002. SAR Inventory: Birds in Fort Beauséjour NHS. Parks Canada, Atlantic, SARINV02-01. 202 recs.
18	Bateman, M.C. 2001. Coastal Waterfowl Surveys Database, 1965-2001. Canadian Wildlife Service, Sackville, 667 recs.
18	Klymko, J.J.D. 2018. 2017 field data. Atlantic Canada Conservation Data Centre.
18	Mazerolle, David. 2020. Botanical fieldwork 2020. Parks Canada.
18	Speers, L. 2008. Butterflies of Canada database: New Brunswick 1897-1999. Agriculture & Agri-Food Canada, Biological Resources Program, Ottawa, 2048 recs.
18	Thomas, A.W. 1996. A preliminary atlas of the butterflies of New Brunswick. New Brunswick Museum.
17	Benedict, B. Connell Herbarium Specimens, Digital photos. University New Brunswick, Fredericton. 2005.
17	Klymko, J.J.D. 2016. 2014 field data. Atlantic Canada Conservation Data Centre.
17	Walker, J. 2017. Bird inventories at French River, NS, and Memramcook, NB, for Nature Conservancy of Canada. Pers. comm. to AC CDC.
16	Allen, K. 2012. Rare plant spatial data from Pleasant Ridge cranberry farm. NB Deparment of Environment, Environmental Assessment Section, 39 recs.
16	McAlpine, D.F. 1983. Status & Conservation of Solution Caves in New Brunswick. New Brunswick Museum, Publications in Natural Science, no. 1, 28pp.
15	Caissie, A. Herbarium Records. Fundy National Park, Alma NB. 1961-1993.
15	Cowie, Faye. 2007. Surveyed Lakes in New Brunswick. Canadian Rivers Institute, 781 recs.
15	Doucet, D.A. 2007. Lepidopteran Records, 1988-2006. Doucet, 700 recs.
15	Neily, T.H. 2019. Tom Neily NS Bryophyte records (2009-2013). T.H. Neily, Atlantic Canada Conservation Data Centre, 1029 specimen records.
15	Roland, A.E. & Smith, E.C. 1969. The Flora of Nova Scotia, 1st Ed. Nova Scotia Museum, Halifax, 743pp.
14	Downes, C. 1998-2000. Breeding Bird Survey Data. Canadian Wildlife Service, Ottawa, 111 recs.
14	Shortt, R. UNB specimen data for various tracked species formerly considered secure. Connell Memorial Herbarium, UNB, Fredericton NB. 2019.
13	Manthorne, A. 2019. Incidental aerial insectivore observations. Birds Canada.
13	Mazerolle, D. 2003. Assessment of Seaside Pinweed (Lechea maritima var. subcylindrica) in Southeastern New Brunswick. Irving Eco-centre, la Dune du Bouctouche, 18 recs.
13	Patrick, A.; Horne, D.; Noseworthy, J. et. al. 2017. Field data for Nova Scotia and New Brunswick, 2015 and 2017. Nature Conservancy of Canada.
12	Blaney, C.S.; Spicer, C.D.; Rothfels, C. 2004. Fieldwork 2004. Atlantic Canada Conservation Data Centre. Sackville NB, 1343 recs.
12	Kouchibouguac National Park, Natural Resource Conservation Sec. 1988. The Resources of Kouchibouguac National Park. Beach, H. (ed.) , 90 recs.
12	Trajkovic, V.K. 2017. Wood turtles inventroy miramichi watershed 2017. Miramichi River Environmental Action Committee, 22 records.
11	Bredin, K.A. 2001. WTF Project: Freshwater Mussel Fieldwork in Freshwater Species data. Atlantic Canada Conservation Data Centere, 101 recs.

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11	Doucet, D.A. & Edsall, J. 2007. Ophiogomphus howei records. Atlantic Canada Conservation Data Centre, Sackville NB, 21 recs.
11	Mills, E. Connell Herbarium Specimens, 1957-2009. University New Brunswick, Fredericton. 2012.
11	Patrick, Allison. 2021. Animal and plant records from NCC properties from 2019 and 2020. Nature Conservancy Canada.
11	Wissink, R. 2000. Rare Plants of Fundy: maps. Parks Canada, 20 recs.
10	Edsall, J. 2001. Lepidopteran records in New Brunswick, 1997-99. , Pers. comm. to K.A. Bredin. 91 recs.
10	Hall, R.A. 2003. NS Freshwater Mussel Fieldwork. Nova Scotia Dept Natural Resources, 189 recs.
10	Hinds, H.R. 1997. Vascular Plants of Cocagne Island. Connell Herbarium, UNB.
10	Munro, Marian K. Tracked lichen specimens, Nova Scotia Provincial Museum of Natural History Herbarium. Atlantic Canada Conservation Data Centre. 2019.
10	Tremblay, E. 2001. Kouchibouguacis River Freshwater Mussel Data. Parks Canada, Kouchibouguac NP, 45 recs.
10	Wisniowski, C. & Dowding, A. 2020. NB species occurrence data for 2020. Nature Trust of New Brunswick.
10	Zinck, M. & Roland, A.E. 1998. Roland's Flora of Nova Scotia. Nova Scotia Museum, 3rd ed., rev. M. Zinck; 2 Vol., 1297 pp.
9	Clayden, S.R. 2005. Confidential supplement to Status Report on Ghost Antler Lichen (Pseudevernia cladonia). Committee on the Status of Endangered Wildlife in Canada, 27 recs.
9	Hall, R.A. 2001. S.. NS Freshwater Mussel Fieldwork. Nova Scotia Dept Natural Resources, 178 recs.
9	Klymko, J. Dataset of butterfly records at the New Brunswick Museum not yet accessioned by the museum. Atlantic Canada Conservation Data Centre. 2016.
9	Mazerolle, M.J., Drolet, B., & Desrochers, A. 2001. Small Mammal Responses to Peat Mining of Southeastern Canadian Bogs. Can. J. Zool., 79:296-302. 21 recs.
9	Richardson, D., Anderson, F., Cameron, R, McMullin, T., Clayden, S. 2014. Field Work Report on Black Foam Lichen (Anzia colpodes). COSEWIC.
8	Blaney, C.S & Spicer, C.D.; Popma, T.M.; Basquill, S.P. 2003. Vascular Plant Surveys of Northumberland Strait Rivers & Amherst Area Peatlands. Nova Scotia Museum Research Grant, 501 recs.
8	Blaney, C.S. Miscellaneous specimens received by ACCDC (botany). Various persons. 2001-08.
8	Haughian, S.R. 2018. Description of Fuscopannaria leucosticta field work in 2017. New Brunswick Museum, 314 recs.
8	Hinds, H.R. 1992. Rare Vascular Plants of Fundy National Park. , 10 recs.
8	Holder, M.L.; Kingsley, A.L. 2000. Kinglsey and Holder observations from 2000 field work.
8	King, Amelia. 2020. Belleisle Watershed Coalition Turtle Watch Data. Belleisle Watershed Coalition.
8	Morton, L.D. & Savoie, M. 1983. The Mammals of Kouchibouguac National Park. Parks Canada Report prep. by Canadian Wildlife Service, Sackville, NB, Vols 1-4. 14 recs.
8	NatureServe Canada. 2018. iNaturalist Butterfly Data Export . iNaturalist.org and iNaturalist.ca.
8	Webster, R.P. 2006. Survey for Suitable Salt Marshes for the Maritime Ringlet, New Populations of the Cobblestone Tiger Beetle, & New Localities of Three Rare Butterfly Species. New Brunswick WTF Report, 28 recs.
7	Amirault, D.L. 2000. Piping Plover Surveys, 1983-2000. Canadian Wildlife Service, Sackville, unpublished data. 70 recs.
7	Bateman, M.C. 2000. Waterfowl Brood Surveys Database, 1990-2000 . Canadian Wildlife Service, Sackville, unpublished data. 149 recs.
7	Benedict, B. Connell Herbarium Specimens. University New Brunswick, Fredericton. 2000.
7	Churchill, J.L. 2019. Atlantic Canada Conservation Data Centre Fieldwork 2019. Atlantic Canada Conservation Data Centre.
7	LaPaix, R.W.; Crowell, M.J.; MacDonald, M.; Neily, T.D.; Quinn, G. 2017. Stantec Nova Scotia rare plant records, 2012-2016. Stantec Consulting.
7	Litvak, M.K. 2001. Shortnose Sturgeon records in four NB rivers. UNB Saint John NB. Pers. comm. to K. Bredin, 6 recs.
7	Sabine, M. 2016. NB DNR staff incidental Black Ash observations. New Brunswick Department of Natural Resources.
7	Scott, F.W. 2002. Nova Scotia Herpetofauna Atlas Database. Acadia University, Wolfville NS, 8856 recs.
7	Shortt, R. Connell Herbarium Black Ash specimens. University New Brunswick, Fredericton. 2019.
7	Staicer, C. & Bliss, S.; Achenbach, L. 2017. Occurrences of tracked breeding birds in forested wetlands. , 303 records.
6	Doucet, D.A. & Edsall, J.; Brunelle, P.-M. 2007. Miramichi Watershed Rare Odonata Survey. New Brunswick ETF & WTF Report, 1211 recs.
6	Elward, D. 2017. 2015-2016 Freshwater Mussel Inventories in the Bouctouche Watershed. Southeastern Anglers Association, 6 recs.
6	Kennedy, Joseph. 2010. New Brunswick Peregrine records, 2010. New Brunswick Dept Natural Resources, 16 recs (11 active).
6	Layberry, R.A. & Hall, P.W., LaFontaine, J.D. 1998. The Butterflies of Canada. University of Toronto Press. 280 pp+plates.
6	Neily, T.H. & Pepper, C.; Toms, B. 2018. Nova Scotia lichen database [as of 2018-03]. Mersey Tobeatic Research Institute.
6	Oldham, M.J. 2000. Oldham database records from Maritime provinces. Oldham, M.J; ONHIC, 487 recs.
6	Westwood, A., Staicer, C. 2016. Nova Scotia landbird Species at Risk observations. Dalhousie University.
6	Wisniowski, C. & Dowding, A. 2019. NB species occurrence data for 2016-2018. Nature Trust of New Brunswick.
5	Basset, I.J. & Crompton, C.W. 1978. The Genus Suaeda (Chenopodiaceae) in Canada. Canadian Journal of Botany, 56: 581-591.
5	Bastien, D. 2017. Rare Peatland plant observations. Pers. comm. to H. Askanas, New Brunswick Department of Energy and Resource Development.
5	Brazner, J. 2016. Nova Scotia Forested Wetland Bird Surveys. Nova Scotia Department of Lands and Forestry.
5	Carter, Jeff; Churchill, J.; Churchill, I.; Churchill, L. 2020. Bank Swallow colony Scots Bay, NS. Atlantic Canada Conservation Data Centre.
5	Porter, Caitlin. 2020. Observations for 26 EcoGifts sites in southwest New Brunswick. Atlantic Canada Conservation Data Centre, 1073 records.
4	Basquill, S.P. 2003. Fieldwork 2003. Atlantic Canada Conservation Data Centre, Sackville NB, 69 recs.
4	Blaney, C.S.; Spicer, C.D. 2001. Fieldwork 2001. Atlantic Canada Conservation Data Centre. Sackville NB, 981 recs.
4	Chaput, G. 2002. Atlantic Salmon: Maritime Provinces Overview for 2001. Dept of Fisheries & Oceans, Atlantic Region, Science Stock Status Report D3-14. 39 recs.
4	Dept of Fisheries & Oceans. 1999. Status of Wild Striped Bass, & Interaction between Wild & Cultured Striped Bass in the Maritime Provinces. , Science Stock Status Report D3-22. 13 recs.
4	Doucet, D.A. 2008. Fieldwork 2008: Odonata. ACCDC Staff, 625 recs.
4	Doucet, D.A. 2008. Wood Turtle Records 2002-07. Pers. comm. to S. Gerriets, 7 recs, 7 recs.
4	e-Butterfly. 2019. Export of Maritimes records and photos. McFarland, K. (ed.) e-butterfly.org.
4	Goltz, J.P. 2002. Botany Ramblings: 1 July to 30 September, 2002. N.B. Naturalist, 29 (3):84-92. 7 recs.
4	Gravel, Mireille. 2010. Coordonnées des tortues des bois Salmon River Road, 2005. Kouchibouguac National Park, 4 recs.
4	Hicklin, P.W. 1995. The Maritime Shorebird Survey Newsletter. Calidris, No. 3. 6 recs.

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4	LaPaix, R.W. 2014. Trans-Canada Energy East Pipeline Environmental Assessment, Records from 2013-14. Stantec Consulting, 5 recs.
4	Neily, T.H. & Pepper, C.; Toms, B. 2020. Nova Scotia lichen database [as of 2020-05-25]. Mersey Tobeatic Research Institute, 668 recs.
4	Olsen, R. Herbarium Specimens. Nova Scotia Agricultural College, Truro. 2003.
4	Phillips, B. 2017. Emails to John Klymko regarding Eastern Waterfan (Peltigera hydrothyria) occurrences in Fundy National Park. Fundy Biosphere Reserve, 3 recs.
4	Popma, K. 2001. Phalarope & other bird observations in Westmorland Co. , Pers. comm. to K.A. Bredin. 5 recs.
4	Sabine, M. 2016. Black Ash records from the NB DNR Forest Development Survey. New Brunswick Department of Natural Resources.
4	Speers, L. 2001. Butterflies of Canada database. Agriculture & Agri-Food Canada, Biological Resources Program, Ottawa, 190 recs.
4	Toms, B. 2018. Bat Species data from www.batconservation.ca for Nova Scotia. Mersey Tobeatic Research Institute, 547 Records.
4	Webster, R.P. & Edsall, J. 2007. 2005 New Brunswick Rare Butterfly Survey. Environmental Trust Fund, unpublished report, 232 recs.
4	Wilhelm, S.I. et al. 2019. Colonial Waterbird Database. Canadian Wildlife Service.
3	Basquill, S.P., Porter, C. 2019. Bryophyte and lichen specimens submitted to the E.C. Smith Herbarium. NS Department of Lands and Forestry.
3	Belland, R.J. 1992. The Bryophytes of Kouchibouguac National Park. Parks Canada, Kouchibouguac NP, 101 pp. + map.
3	Clayden, S.R. 2006. Pseudevernia cladonia records. NB Museum. Pers. comm. to S. Blaney, Dec, 4 recs.
3	Ferguson, D.C. 1954. The Lepidoptera of Nova Scotia. Part I, macrolepidoptera. Proceedings of the Nova Scotian Institute of Science, 23(3), 161-375.
3	Forbes, G. 2001. Bog Lemming, Phalarope records, NB. , Pers. comm. to K.A. Bredin. 6 recs.
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3	Grondin, P. & Blouin, J-L., Bouchard, D.; et al. 1981. Description et cartographie de la vegetation du cordon littoral. Parc National de Kouchibouguac. Le Groupe Dryade, 57 pp.
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Appendix B

Results of the Functional Wetland Assessment

Wetland 1

Total Size: 2.93

Wetland 1A: **Disturbed Field Condition**

Wetland Classification: Disturbed field wetland
Dominant Wetland Vegetation? Yes

- Trees: none
- Shrubs: 5% willow (*Salix* spp.; FAC)[1, 2]
- Herbs: 40% bluejoint reed grass (*Calamagrostis canadensis*; FACW), 40% dark green bulrush (*Scirpus atrovirens*; FACW), 15% sensitive fern (*Onoclea sensibilis*; FACW), 2% golden groundsel (*Packera aurea*; FACW), tufted vetch (*Vicia cracca*; FAC), goldenrod (*Solidago* spp.; FAC), spotted touch-me-not (*Impatiens capensis*; FAC)

Primary Wetland Hydrology Indicators: surface water, high water table, saturation
Secondary Wetland Hydrology Indicators: none
Soil Profile:

Depth (cm)	Colour (Munsell Color 2009)	Redox	Texture
5-0	Decomposing organics		
0-10	2.5 YR 2/1	-	Clayey organics
10-30	Gley 1 2.5/N	-	Clay
30-41	Gley 1 5/10GY	-	Clay
41-51	5YR 4/4	-	Coarse loam
51	Restrictive layer of gravels – possible glacial till or former plow layer from farming		

Hydric Soil Indicators: gleyed matrix

Photo 1: **Representative Photo of W**etland 1A (July 19, 2022)

[1] Percent cover is calculated by each vegetation layer (i.e., trees, shrubs, herbs); therefore, almost always equals >100% total if there are three strata.
[2] OLB = obligate wetland, FACW = facultative wetland, FAC = facultative, FACU = facultative upland, UPL = upland. Hydrophytic vegetation indicator status, based on the Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987).

Wetland 1B: Willow Swale Condition

Wetland Classification: Willow swale
Dominant Wetland Vegetation? Yes

- Trees: none
- Shrubs: 60% willows (FAC), 50% red osier dogwood (*Cornus sericea*; FACW)
- Herbs: 15% bluejoint reed grass (FACW), 5% slender manna grass (*Glyceria melicaria*; OBL), 5% dwarf red raspberry (*Rubus pubescens*; FAC), 5% horsetails (*Equisetum* spp.; OBL/FAC); 5% large-leaved avens (*Geum macropyllum*; FACW), 1% tufted vetch, 1% star sedge (*Carex echinata*; OBL), 1% ragged fringed orchid (*Platanthera lacera*; FACW)

Primary Wetland Hydrology Indicators: high water table (30 cm), saturation
Secondary Wetland Hydrology Indicators: none

Soil Profile:

Depth (cm)	Colour (Munsell Color 2009)	%	Redox	%	Texture
0-13	10YR 2/1	100	-	0	Black muck & organics
13-33	7.5YR 3/3	95	Gley1 5/5G_/2	5	Clay
33-56	7.5YR 3/3	100	-	0	Coarse material with clay matrix
56	Restrictive layer of gravels				

Photo 2: **Representative Photo of Wetland 1B** (July 19, 2022)

[1] Percent cover is calculated by each vegetation layer (i.e., trees, shrubs, herbs); therefore, almost always equals >100% total if there are three strata.
[2] OLB = obligate wetland, FACW = facultative wetland, FAC = facultative, FACU = facultative upland, UPL = upland. Hydrophytic vegetation indicator status, based on the Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987).

Forested Condition

Wetland Classification: Forested riparian wetland
Dominant Wetland Vegetation? Yes

- Trees: 20% Eastern white cedar (*Thuja occidentalis*; FACW); 10% white birch (*Betula papyrifera*; FACU), 10% balsam fir (*Abies balsamea*; FAC); 10% tamarack (*Larix laricina*; FAC), 10% trembling aspen (*Populus tremuloides*; FAC)
- Shrubs: 3% beaked hazelnut (*Corylus cornuta*; FAC), 2% trembling aspen (FAC), 1% white ash (*Fraxinus americana*; FAC); 1% red osier dogwood (FACW), 1% round-leaved dogwood (*Cornus rugose*; UPL), 1% glossy buckthorn (*Frangula alnus*; FAC)
- Herbs: 30% sensitive fern (FACW), 10% bluejoint reed grass (FACW), 5% creeping buttercup (*Ranunculus repens*; FAC), 5% small enchanter's nightshade (*Circaea alplina*; FAC), 2% spotted touch-me-not (FAC), 2% jack-in-the-pulpit (*Arisaema triphyllum*; FACW), 2% dwarf red raspberry (FAC), common marsh bedstraw (*Galium palustre*; FACW), helleborine (*Epipactus helleborine*; FAC)

Primary Wetland Hydrology Indicators: high water table (30 cm), drift deposits, aquatic fauna – 10 cm of surface water in stream running through wetland
Secondary Wetland Hydrology Indicators: drainage patterns

Soil Profile:

Depth (cm)	Colour (Munsell Color 2009)	%	Redox	%	Texture
0-41	10YR 2/1	100	-	0	Black muck & organics
41-66	5YR 4/4	100	-	0	Clay with coarse material throughout
66	Restrictive layer – clay pan?				

Hydric Soil Indicators: Histosol

Photo 3: **Representative Photo of Wetland 1C** (July 19, 2022)

[1] Percent cover is calculated by each vegetation layer (i.e., trees, shrubs, herbs); therefore, almost always equals >100% total if there are three strata.
[2] OLB = obligate wetland, FACW = facultative wetland, FAC = facultative, FACU = facultative upland, UPL = upland. Hydrophytic vegetation indicator status, based on the Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987).

Assessment Area (AA) Results:

Wetland ID: Glenvale Wetland 1

Date: September 2022

Observer: Chris Kennedy

Latitude & Longitude (decimal degrees): 45.934304, -65.222425

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	2.61	Moderate	3.19	Moderate	3.74	3.25
Stream Flow Support (SFS)	2.81	Lower	6.02	Moderate	1.50	3.51
Water Cooling (WC)	6.60	Higher	2.46	Moderate	4.40	1.48
Sediment Retention & Stabilisation (SR)	2.34	Moderate	7.57	Moderate	4.76	4.60
Phosphorus Retention (PR)	3.70	Moderate	7.08	Higher	5.53	6.74
Nitrate Removal & Retention (NR)	1.11	Lower	10.00	Higher	4.51	10.00
Carbon Sequestration (CS)	3.43	Moderate			6.04	
Organic Nutrient Export (OE)	5.86	Higher			5.44	
Anadromous Fish Habitat (FA)	6.15	Moderate	4.16	Moderate	3.77	3.08
Resident Fish Habitat (FR)	3.89	Moderate	4.34	Moderate	2.31	3.08
Aquatic Invertebrate Habitat (INV)	5.96	Higher	6.78	Higher	5.97	4.90
Amphibian & Turtle Habitat (AM)	5.73	Moderate	4.96	Moderate	6.33	5.10
Waterbird Feeding Habitat (WBF)	6.77	Moderate	3.33	Moderate	5.39	3.33
Waterbird Nesting Habitat (WBN)	4.93	Moderate	2.50	Moderate	4.21	2.50
Songbird, Raptor, & Mammal Habitat (SBM)	8.93	Higher	2.50	Lower	7.41	2.50
Pollinator Habitat (POL)	8.32	Higher	0.00	Lower	6.70	0.00
Native Plant Habitat (PH)	4.10	Moderate	5.42	Moderate	4.74	4.70
Public Use & Recognition (PU)			2.24	Lower		1.92
Wetland Sensitivity (Sens)			7.32	Higher		4.39
Wetland Ecological Condition (EC)			2.89	Lower		5.90
Wetland Stressors (STR) (higher score means more stress)			4.65	Moderate		3.97
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	2.81	Moderate	3.19	Moderate	3.74	3.25
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	3.04	Lower	9.11	Higher	5.63	8.56
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	5.95	Moderate	5.94	Higher	5.15	4.10
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	6.13	Moderate	4.41	Moderate	5.37	4.26
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	8.03	Higher	4.03	Moderate	6.84	3.55
WETLAND CONDITION (EC)			2.89	Lower		5.90
WETLAND RISK (average of Sensitivity & Stressors)			5.98	Higher		4.18

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among the 98 NB calibration wetlands that were assessed previously.

Wetland 2

Size: 1.49 ha
Wetland Classification: mixed-wood riparian wetland
Dominant Wetland Vegetation? Yes

- Trees: 10% black cherry (*Prunus serotina*; FAC), 2% Eastern white cedar (FACW), 2% white ash (FAC)
- Shrubs: 15% speckled alder (*Alnus incana*; FACW), 15% black cherry (FAC), 5% alternate-leaved dogwood (*Cornus alternifolia*; FAC), 2% American white elm (*Ulmus americana*; FAC), 2% highbush cranberry (*Viburnum opulus*; FACW), 2% Eastern white cedar (FACW), 2% red osier dogwood (FACW)
- Herbs: 60% sensitive fern (FACW), 2% dwarf red raspberry (FAC), 2% creeping buttercup (FAC), 2% spotted touch-me-not (FAC), 1% small enchanter's nightshade (FAC), 1% bittersweet nightshade (*Solanum dulcamara*; FAC), 1% crested wood fern (*Dryopteris cristata*; FACW)

Primary Wetland Hydrology Indicators: saturation, drift deposits, high water table (30 cm), water-stained leaves, un-vegetated concave surface
Secondary Wetland Hydrology Indicators: drainage patterns

Soil Profile:

Depth (cm)	Colour (Munsell Color 2009)	%	Redox	%	Texture
0-15	10YR 2/1	100	-	0	Black muck & organics
15-28	7.5 YR 3/2	95	7.5 YR 5/1 (leached)	5	Clay-silt
28	Restrictive layer – coarse gravel				

Photo 4: **Representative Photo of Wetland 2** (July 20, 2022)

[1] Percent cover is calculated by each vegetation layer (i.e., trees, shrubs, herbs); therefore, almost always equals >100% total if there are three strata.
[2] OLB = obligate wetland, FACW = facultative wetland, FAC = facultative, FACU = facultative upland, UPL = upland. Hydrophytic vegetation indicator status, based on the Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987).

Assessment Area (AA) Results:

Wetland ID: Glenvale Wetland 2

Date: July 2022

Observer: Chris Kennedy

Latitude & Longitude (decimal degrees): 45.932359, -65.219096

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	**Function Score (Normalised)**	Function Rating	**Benefits Score (Normalised)**	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	2.98	Moderate	3.22	Moderate	4.02	3.28
Stream Flow Support (SFS)	2.81	Lower	7.03	Higher	1.50	4.10
Water Cooling (WC)	7.80	Higher	3.10	Moderate	5.20	1.86
Sediment Retention & Stabilisation (SR)	2.48	Moderate	7.73	Moderate	4.85	4.69
Phosphorus Retention (PR)	3.14	Moderate	7.08	Higher	5.13	6.74
Nitrate Removal & Retention (NR)	2.00	Lower	10.00	Higher	5.06	10.00
Carbon Sequestration (CS)	2.25	Lower			5.53	
Organic Nutrient Export (OE)	7.63	Higher			6.38	
Anadromous Fish Habitat (FA)	9.23	Higher	4.41	Moderate	5.65	3.26
Resident Fish Habitat (FR)	5.16	Moderate	4.60	Higher	3.07	3.26
Aquatic Invertebrate Habitat (INV)	7.68	Higher	6.90	Higher	6.58	4.96
Amphibian & Turtle Habitat (AM)	4.46	Moderate	4.32	Moderate	5.66	4.71
Waterbird Feeding Habitat (WBF)	5.43	Moderate	3.33	Moderate	4.32	3.33
Waterbird Nesting Habitat (WBN)	4.41	Moderate	2.50	Moderate	3.77	2.50
Songbird, Raptor, & Mammal Habitat (SBM)	8.83	Higher	2.50	Lower	7.32	2.50
Pollinator Habitat (POL)	7.42	Moderate	0.00	Lower	5.97	0.00
Native Plant Habitat (PH)	6.22	Higher	5.11	Moderate	5.59	4.43
Public Use & Recognition (PU)			2.29	Lower		1.96
Wetland Sensitivity (Sens)			6.86	Higher		4.26
Wetland Ecological Condition (EC)			4.22	Moderate		6.67
Wetland Stressors (STR) (higher score means more stress)			4.66	Moderate		3.97
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	2.98	Moderate	3.22	Moderate	4.02	3.28
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	2.80	Lower	9.13	Higher	5.34	8.57
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	7.14	Higher	6.35	Higher	5.75	4.30
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	7.48	Higher	4.22	Moderate	5.08	4.06
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	8.16	Higher	3.82	Moderate	6.81	3.37
WETLAND CONDITION (EC)			4.22	Moderate		6.67
WETLAND RISK (average of Sensitivity & Stressors)			5.76	Higher		4.11

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among the 98 NB calibration wetlands that were assessed previously.

Wetland 3

Size: 0.44 ha
Wetland Classification: mixed-wood riparian swamp
Dominant Wetland Vegetation? Yes

- Trees: 5% balsam fir, 5% red spruce (*Picea rubens*; FAC), 1% red maple (*Acer rubrum*; FAC)
- Shrubs: 40% black cherry (FAC), 10% speckled alder (FACW), 1% willow (FACW), 1% red raspberry (*Rubus idaeus*; FAC)
- Herbs: 60% ostrich fern (*Matteuccia struthiopteris*; FACW), 10% European red currant (*Ribes rubrum*; FAC), 1% zigzag goldenrod (*Solidago flexicauliszi; FACU),* 1% rough sedge (*Carex scabrata*; OBL), 1% nodding sedge (*Carex gynandra;* FACW), 1% sensitive fern, 1% small enchanter's nightshade (FAC), 1% tall meadow-rue (*Thalictrum pubescens*; FACW), 1% dwarf red raspberry (FAC)

Primary Wetland Hydrology Indicators: sediment deposits, drift deposits, water-stained leaves, aquatic fauna
Secondary Wetland Hydrology Indicators: drainage patterns

Soil Profile:

Depth (cm)	Colour (Munsell Color 2009)	%	Redox	%	Texture
0-15	7.5YR 2.5/2	100	-	0	Clay loam
15-30	5YR3/3	100	-	0	Clay
30-45	7.5YR3/3	95	5YR4/6	5	Clay
45-61	10YR3/1	100	-	0	Clay
61	Gravel restrictive layer				

Hydric Soil Indicators: depleted matrix

Photo 5: **Representative Photo of Wetland 3** (July 20, 2022)

[1] Percent cover is calculated by each vegetation layer (i.e., trees, shrubs, herbs); therefore, almost always equals >100% total if there are three strata.
[2] OLB = obligate wetland, FACW = facultative wetland, FAC = facultative, FACU = facultative upland, UPL = upland. Hydrophytic vegetation indicator status, based on the Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987).

Assessment Area (AA) Results:

Wetland ID: Glenvale Wetland 3

Date: July 2022

Observer: Chris Kennedy

Latitude & Longitude (decimal degrees): 45.93566, -065.213857

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	**Function Score (Normalised)**	Function Rating	**Benefits Score (Normalised)**	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	3.23	Moderate	3.07	Moderate	4.21	3.13
Stream Flow Support (SFS)	2.55	Lower	5.57	Moderate	1.36	3.25
Water Cooling (WC)	8.90	Higher	2.45	Moderate	5.93	1.47
Sediment Retention & Stabilisation (SR)	2.81	Moderate	7.86	Moderate	5.08	4.77
Phosphorus Retention (PR)	3.24	Moderate	7.39	Higher	5.20	7.01
Nitrate Removal & Retention (NR)	1.32	Lower	10.00	Higher	4.64	10.00
Carbon Sequestration (CS)	3.29	Moderate			5.98	
Organic Nutrient Export (OE)	7.48	Higher			6.30	
Anadromous Fish Habitat (FA)	4.59	Moderate	3.77	Moderate	2.81	2.78
Resident Fish Habitat (FR)	4.59	Moderate	3.50	Moderate	2.73	2.48
Aquatic Invertebrate Habitat (INV)	7.31	Higher	6.06	Higher	6.44	4.51
Amphibian & Turtle Habitat (AM)	3.88	Moderate	5.92	Moderate	5.35	5.68
Waterbird Feeding Habitat (WBF)	5.55	Moderate	5.00	Moderate	4.42	5.00
Waterbird Nesting Habitat (WBN)	4.82	Moderate	5.00	Moderate	4.12	5.00
Songbird, Raptor, & Mammal Habitat (SBM)	9.20	Higher	5.00	Moderate	7.63	5.00
Pollinator Habitat (POL)	7.11	Moderate	0.00	Lower	5.73	0.00
Native Plant Habitat (PH)	5.81	Moderate	5.13	Moderate	5.43	4.45
Public Use & Recognition (PU)			2.05	Lower		1.79
Wetland Sensitivity (Sens)			6.81	Higher		4.24
Wetland Ecological Condition (EC)			5.66	Moderate		7.50
Wetland Stressors (STR) (higher score means more stress)			4.33	Moderate		3.85
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	2.55	Moderate	3.07	Moderate	4.21	3.13
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	2.85	Lower	9.21	Higher	5.60	8.63
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	7.73	Higher	5.37	Higher	5.73	3.79
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	5.12	Moderate	5.28	Moderate	4.62	4.94
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	8.29	Higher	4.25	Moderate	6.94	4.08
WETLAND CONDITION (EC)			5.66	Moderate		7.50
WETLAND RISK (average of Sensitivity & Stressors)			5.57	Higher		4.05

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among the 98 NB calibration wetlands that were assessed previously.

Wetland 4

Size: 0.28 ha
Wetland Classification: formed in a wetland due to karst topography
Dominant Wetland Vegetation? Yes

- Trees: 10% red maple (FAC), 1% Eastern white cedar (FACW)
- Shrubs: 2% Eastern white cedar (FACW), 2% beaked hazelnut (FAC), 1% willow species (FACw)
- Herbs: 15% swamp smartweed (*Persicaria hydropiperoides*; OBL), 5% bittersweet nightshade (FAC), 5% sensitive fern (FACW), 5% spotted cowbane (*Cicuta maculate*; OBL); 2% marsh skullcap (*Scutellaria galericulata*; OBL), 2% St. John's Wort (*Hypericum*; FACW), 2% common marsh bedstraw (FACW), 2% nodding sedge (FACW)

Primary Wetland Hydrology Indicators: surface water (> 50 cm), high water table, saturation, water-stained leaves, aquatic fauna (dragonflies, frogs), hydrogen sulphide odour
Secondary Wetland Hydrology Indicators: geomorphic position

Soil Profile:

Depth (cm)	Colour (Munsell Color 2009)	%	Redox	%	Texture
5-0	-	100	-	0	Black organic matter
0-13	5YR 2.5/1	100	-	0	Clayey
13-23	2.5Y 5/2	90	10R 5/6	10	Sandy
23-107	Clay pan- not saturated				

Hydric Soil Indicators: sandy redox

Photo 6: Soil Profile of Wetland 4 (July 21, 2022)

Photo 7: Representative Photo of Wetland 4 (July 21, 2022)

[1] Percent cover is calculated by each vegetation layer (i.e., trees, shrubs, herbs); therefore, almost always equals >100% total if there are three strata.
[2] OLB = obligate wetland, FACW = facultative wetland, FAC = facultative, FACU = facultative upland, UPL = upland. Hydrophytic vegetation indicator status, based on the Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987).

Assessment Area (AA) Results:

Wetland ID: Glenvale Wetland 4

Date: July 2022

Observer: Chris Kennedy

Latitude & Longitude (decimal degrees): 45.938258, -065.220891

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	7.29	Higher	0.80	Lower	7.34	0.88
Stream Flow Support (SFS)	0.00	Lower	0.00	Lower	0.00	0.00
Water Cooling (WC)	1.54	Lower	0.00	Lower	1.03	0.00
Sediment Retention & Stabilisation (SR)	10.00	Higher	0.67	Lower	10.00	0.41
Phosphorus Retention (PR)	10.00	Higher	0.00	Lower	10.00	0.33
Nitrate Removal & Retention (NR)	10.00	Higher	4.38	Moderate	10.00	5.00
Carbon Sequestration (CS)	3.06	Lower			5.88	
Organic Nutrient Export (OE)	3.48	Moderate			4.18	
Anadromous Fish Habitat (FA)	0.00	Lower	0.00	Lower	0.00	0.00
Resident Fish Habitat (FR)	0.00	Lower	0.00	Lower	0.00	0.00
Aquatic Invertebrate Habitat (INV)	6.53	Higher	4.24	Moderate	6.17	3.53
Amphibian & Turtle Habitat (AM)	9.20	Higher	1.28	Lower	8.16	2.87
Waterbird Feeding Habitat (WBF)	7.66	Higher	2.50	Moderate	6.10	2.50
Waterbird Nesting Habitat (WBN)	8.11	Higher	2.50	Moderate	6.93	2.50
Songbird, Raptor, & Mammal Habitat (SBM)	0.00	Lower	0.00	Lower	0.00	0.00
Pollinator Habitat (POL)	0.00	Lower	0.00	Lower	0.00	0.00
Native Plant Habitat (PH)	2.60	Lower	0.00	Lower	4.13	0.00
Public Use & Recognition (PU)			0.49	Lower		0.68
Wetland Sensitivity (Sens)			7.62	Higher		4.48
Wetland Ecological Condition (EC)			2.29	Lower		5.56
Wetland Stressors (STR) (higher score means more stress)			0.28	Lower		2.36
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	0.00	Lower	0.80	Lower	7.34	0.88
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	10.00	Higher	3.03	Lower	9.49	3.46
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	4.71	Moderate	2.83	Moderate	4.51	2.35
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	7.10	Higher	1.88	Lower	6.20	2.22
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	1.74	Lower	0.00	Lower	2.76	0.00
WETLAND CONDITION (EC)			2.29	Lower		5.56
WETLAND RISK (average of Sensitivity & Stressors)			3.95	Moderate		3.42

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among the 98 NB calibration wetlands that were assessed previously.

Wetland 5

Size: 0.39 ha
Wetland Classification: formed in a depression due to karst topography
Dominant Wetland Vegetation? Yes

- Trees: 1% red maple (FAC), 1% Eastern white cedar (FACW)
- Shrubs: 1% red osier dogwood (FACW)
- Herbs: 80% common duckweed (*Lemna minor*; OBL), 10% sensitive fern (FACW), 2% common water parsnip (*Sium suave*; OBL); 1% marsh skullcap (OBL), 1% common marsh bedstraw (FACW+), 1% northern bugleweed (*Lycopus unifloris*; FACW+), 1% devil's beggarticks (*Bidens frondosa*; FACW)

Primary Wetland Hydrology Indicators: surface water (20 cm), high water table, saturation, hydrogen sulphide odour
Secondary Wetland Hydrology Indicators: none

Soil Profile:

Depth (cm)	Colour (Munsell Color 2009)	%	Redox	%	Texture
0-122+	10YR 2/1	100	-	0	Organics
No restrictive layer encountered					

Hydric Soil Indicators: histosol, hydrogen sulphide

Photo 8: **Representative Photo of Wetland 5** (September 15, 2022)

Photo 9: Soil Substrate of Wetland 5 (September 15, 2022)

[1] Percent cover is calculated by each vegetation layer (i.e., trees, shrubs, herbs); therefore, almost always equals >100% total if there are three strata.
[2] OLB = obligate wetland, FACW = facultative wetland, FAC = facultative, FACU = facultative upland, UPL = upland. Hydrophytic vegetation indicator status, based on the Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987).

Assessment Area (AA) Results:

Wetland ID: Glenvale Wetland 5

Date: July 2022

Observer: Chris Kennedy

Latitude & Longitude (decimal degrees): 45.939077, -065.219670

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	**Function Score (Normalised)**	Function Rating	**Benefits Score (Normalised)**	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	5.06	Moderate	0.75	Lower	5.62	0.83
Stream Flow Support (SFS)	2.26	Lower	4.51	Moderate	1.20	2.63
Water Cooling (WC)	4.38	Moderate	0.56	Lower	2.92	0.34
Sediment Retention & Stabilisation (SR)	4.25	Moderate	1.29	Lower	6.06	0.79
Phosphorus Retention (PR)	4.07	Moderate	0.78	Lower	5.79	1.04
Nitrate Removal & Retention (NR)	1.59	Lower	4.38	Moderate	4.81	5.00
Carbon Sequestration (CS)	3.91	Moderate			6.25	
Organic Nutrient Export (OE)	6.62	Higher			5.84	
Anadromous Fish Habitat (FA)	0.00	Lower	0.00	Lower	0.00	0.00
Resident Fish Habitat (FR)	0.00	Lower	0.00	Lower	0.00	0.00
Aquatic Invertebrate Habitat (INV)	5.70	Higher	4.01	Moderate	5.88	3.41
Amphibian & Turtle Habitat (AM)	4.41	Moderate	3.63	Moderate	5.63	4.30
Waterbird Feeding Habitat (WBF)	5.79	Moderate	10.00	Higher	4.61	10.00
Waterbird Nesting Habitat (WBN)	5.17	Moderate	10.00	Higher	4.42	10.00
Songbird, Raptor, & Mammal Habitat (SBM)	6.97	Moderate	2.50	Lower	5.78	2.50
Pollinator Habitat (POL)	8.91	Higher	0.00	Lower	7.17	0.00
Native Plant Habitat (PH)	5.14	Moderate	4.98	Moderate	5.16	4.32
Public Use & Recognition (PU)			2.32	Lower		1.98
Wetland Sensitivity (Sens)			2.98	Moderate		3.10
Wetland Ecological Condition (EC)			2.77	Lower		5.83
Wetland Stressors (STR) (higher score means more stress)			5.85	Higher		4.41
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	2.26	Lower	0.75	Lower	5.62	0.83
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	3.78	Moderate	3.26	Lower	5.99	3.64
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	5.68	Moderate	3.77	Moderate	4.92	2.77
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	4.43	Moderate	7.36	Higher	4.28	7.43
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	7.96	Higher	3.73	Moderate	6.61	3.30
WETLAND CONDITION (EC)			2.77	Lower		5.83
WETLAND RISK (average of Sensitivity & Stressors)			4.42	Higher		3.75

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among the 98 NB calibration wetlands that were assessed previously.

Wetland 6

Size: 0.52 ha
Wetland Classification: formed in a depression due to karst topography
Dominant Wetland Vegetation? Yes

- Trees: 15% red maple (FAC), 5% balsam fir (FAC)
- Shrubs: none
- Herbs: 40% sensitive fern (FACW), 10% cinnamon fern (FAC), 5% New York Fern (*Thelypteris noveboracensis*; FAC)

Primary Wetland Hydrology Indicators: saturation, sparsely vegetated concave surface, water-stained leaves, aquatic fauna, high water table (30 cm)
Secondary Wetland Hydrology Indicators: drainage patterns

Soil Profile:

Depth (cm)	Colour (Munsell Color 2009)	%	Redox	%	Texture
0-48+	5YR 2.5/1	100	-	0	Clayey loam mixed with decomposing organics

No restrictive layer encountered

Hydric Soil Indicators: histosol

Photo 10: **Representative Photo of Wetland 6** (July 21, 2022)

Photo 11: Soil Substrate of Wetland 6 (July 21, 2022)

[1] Percent cover is calculated by each vegetation layer (i.e., trees, shrubs, herbs); therefore, almost always equals >100% total if there are three strata.
[2] OLB = obligate wetland, FACW = facultative wetland, FAC = facultative, FACU = facultative upland, UPL = upland. Hydrophytic vegetation indicator status, based on the Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987).

Assessment Area (AA) Results:

Wetland ID: Glenvale Wetland 6

Date: July 2022

Observer: Chris Kennedy

Latitude & Longitude (decimal degrees): 45.938105, -065.219304

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	**Function Score (Normalised)**	Function Rating	**Benefits Score (Normalised)**	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	7.57	Higher	0.80	Lower	7.55	0.88
Stream Flow Support (SFS)	0.00	Lower	0.00	Lower	0.00	0.00
Water Cooling (WC)	1.54	Lower	0.00	Lower	1.03	0.00
Sediment Retention & Stabilisation (SR)	10.00	Higher	0.67	Lower	10.00	0.41
Phosphorus Retention (PR)	10.00	Higher	0.00	Lower	10.00	0.33
Nitrate Removal & Retention (NR)	10.00	Higher	4.38	Moderate	10.00	5.00
Carbon Sequestration (CS)	3.82	Moderate			6.21	
Organic Nutrient Export (OE)	4.27	Moderate			4.60	
Anadromous Fish Habitat (FA)	0.00	Lower	0.00	Lower	0.00	0.00
Resident Fish Habitat (FR)	0.00	Lower	0.00	Lower	0.00	0.00
Aquatic Invertebrate Habitat (INV)	6.01	Higher	4.64	Moderate	5.99	3.75
Amphibian & Turtle Habitat (AM)	9.39	Higher	1.68	Lower	8.26	3.11
Waterbird Feeding Habitat (WBF)	8.58	Higher	10.00	Higher	6.82	10.00
Waterbird Nesting Habitat (WBN)	8.66	Higher	10.00	Higher	7.40	10.00
Songbird, Raptor, & Mammal Habitat (SBM)	0.00	Lower	0.00	Lower	0.00	0.00
Pollinator Habitat (POL)	0.00	Lower	0.00	Lower	0.00	0.00
Native Plant Habitat (PH)	3.64	Lower	0.00	Lower	4.55	0.00
Public Use & Recognition (PU)			0.76	Lower		0.87
Wetland Sensitivity (Sens)			5.59	Higher		3.88
Wetland Ecological Condition (EC)			0.96	Lower		4.79
Wetland Stressors (STR) (higher score means more stress)			2.34	Moderate		3.12
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	0.00	Lower	0.80	Lower	7.55	0.88
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	10.00	Higher	3.03	Lower	9.53	3.46
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	4.48	Moderate	3.10	Moderate	4.45	2.50
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	7.36	Higher	7.17	Higher	6.38	7.31
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	2.43	Lower	0.00	Lower	3.04	0.00
WETLAND CONDITION (EC)			0.96	Lower		4.79
WETLAND RISK (average of Sensitivity & Stressors)			3.97	Moderate		3.50

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among the 98 NB calibration wetlands that were assessed previously.

Wetland 7

Size: 0.03 ha
Wetland Classification: formed in a depression due to karst topography
Dominant Wetland Vegetation? Yes

- Trees: none
- Shrubs: none
- Herbs: 80% common duckweed

Primary Wetland Hydrology Indicators: surface water, high water table, saturation
Secondary Wetland Hydrology Indicators: none

Soil Profile: wetland soil entirely covered by surface water, but likely organics

Notes: not much of a fringe on the wetland

Photo 12: **Representative Photo of Wetland 7 Showing** Late Summer Duckweed (September 15, 2022)

Photo 13: **Representative Photo of Wetland 7** (July 21, 2022)

[1] Percent cover is calculated by each vegetation layer (i.e., trees, shrubs, herbs); therefore, almost always equals >100% total if there are three strata.
[2] OLB = obligate wetland, FACW = facultative wetland, FAC = facultative, FACU = facultative upland, UPL = upland. Hydrophytic vegetation indicator status, based on the Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987).

Assessment Area (AA) Results:

Wetland ID: Glenvale Wetland 7

Date: September 2022

Observer: Chris Kennedy

Latitude & Longitude (decimal degrees): 45.935197, -065.223385

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	6.09	Higher	0.77	Lower	6.41	0.85
Stream Flow Support (SFS)	0.00	Lower	0.00	Lower	0.00	0.00
Water Cooling (WC)	1.54	Lower	0.00	Lower	1.03	0.00
Sediment Retention & Stabilisation (SR)	10.00	Higher	0.37	Lower	10.00	0.22
Phosphorus Retention (PR)	10.00	Higher	0.00	Lower	10.00	0.33
Nitrate Removal & Retention (NR)	10.00	Higher	4.38	Moderate	10.00	5.00
Carbon Sequestration (CS)	1.70	Lower			5.30	
Organic Nutrient Export (OE)	2.96	Lower			3.90	
Anadromous Fish Habitat (FA)	0.00	Lower	0.00	Lower	0.00	0.00
Resident Fish Habitat (FR)	0.00	Lower	0.00	Lower	0.00	0.00
Aquatic Invertebrate Habitat (INV)	5.79	Higher	4.30	Moderate	5.91	3.56
Amphibian & Turtle Habitat (AM)	9.30	Higher	1.29	Lower	8.21	2.87
Waterbird Feeding Habitat (WBF)	7.69	Higher	3.33	Moderate	6.12	3.33
Waterbird Nesting Habitat (WBN)	8.23	Higher	2.50	Moderate	7.03	2.50
Songbird, Raptor, & Mammal Habitat (SBM)	0.00	Lower	0.00	Lower	0.00	0.00
Pollinator Habitat (POL)	0.00	Lower	0.00	Lower	0.00	0.00
Native Plant Habitat (PH)	2.22	Lower	0.00	Lower	3.98	0.00
Public Use & Recognition (PU)			0.68	Lower		0.81
Wetland Sensitivity (Sens)			9.57	Higher		5.07
Wetland Ecological Condition (EC)			1.33	Lower		5.00
Wetland Stressors (STR) (higher score means more stress)			0.37	Lower		2.40
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	0.00	Lower	0.77	Lower	6.41	0.85
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	10.00	Higher	2.98	Lower	9.41	3.43
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	4.18	Moderate	2.86	Moderate	4.31	2.37
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	7.17	Higher	2.38	Lower	6.24	2.54
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	1.48	Lower	0.00	Lower	2.65	0.00
WETLAND CONDITION (EC)			1.33	Lower		5.00
WETLAND RISK (average of Sensitivity & Stressors)			4.97	Higher		3.73

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among the 98 NB calibration wetlands that were assessed previously.

Wetland 8

Size: 0.2 ha
Wetland Classification: disturbed alder swale
Dominant Wetland Vegetation? Yes

- Trees: none
- Shrubs: 75% speckled alder (FACW), 5% black cherry (FAC), 2% serviceberry (*Amelanchier* spp.; FAC), 2% balsam fir (FAC), 1% common/black elderberry (*Sambucus nigra var. Canadensis*; FACW)
- Herbs: 5% bristly dewberry (*Rubus hispidus*; FACW), 5% bluejoint reed grass (FACW), 5% slender manna grass (OBL), 2% sensitive fern (FACW), 1% wild strawberry (*Fragaria virginiana*; FAC), 1% large-leaved avens (FACW), 1% field horsetail (*Equisetum arvense*; FAC)

Primary Wetland Hydrology Indicators: drift deposits
Secondary Wetland Hydrology Indicators: drainage patterns
Soil Profile:

Depth (cm)	Colour (Munsell Color 2009)	%	Redox	%	Texture
0-20	10R 3/2	100	-	0	Clay loam
20-61	10R ¾	95	10YR 5/8	2	Loam
			10YR 5/2 (leached)	3	

No restrictive layer encountered

Photo 14: **Representative Photo of Wetland 8** (September 15, 2022)

[1] Percent cover is calculated by each vegetation layer (i.e., trees, shrubs, herbs); therefore, almost always equals >100% total if there are three strata.
[2] OLB = obligate wetland, FACW = facultative wetland, FAC = facultative, FACU = facultative upland, UPL = upland. Hydrophytic vegetation indicator status, based on the Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987).

Assessment Area (AA) Results:

Wetland ID: Glenvale Wetland 8

Date: September 2022

Observer: Chris Kennedy

Latitude & Longitude (decimal degrees): 45.935382, -065.217617

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	**Function Score (Normalised)**	Function Rating	**Benefits Score (Normalised)**	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	2.92	Moderate	4.40	Moderate	3.98	4.45
Stream Flow Support (SFS)	1.88	Lower	3.86	Moderate	1.00	2.25
Water Cooling (WC)	0.00	Lower	0.00	Lower	0.00	0.00
Sediment Retention & Stabilisation (SR)	1.72	Lower	8.31	Higher	4.33	5.05
Phosphorus Retention (PR)	2.92	Moderate	8.00	Higher	4.97	7.57
Nitrate Removal & Retention (NR)	0.00	Lower	10.00	Higher	3.34	10.00
Carbon Sequestration (CS)	0.00	Lower			4.49	
Organic Nutrient Export (OE)	5.02	Moderate			5.00	
Anadromous Fish Habitat (FA)	0.00	Lower	0.00	Lower	0.00	0.00
Resident Fish Habitat (FR)	0.00	Lower	0.00	Lower	0.00	0.00
Aquatic Invertebrate Habitat (INV)	3.44	Moderate	0.35	Lower	5.08	1.43
Amphibian & Turtle Habitat (AM)	2.33	Lower	0.15	Lower	4.53	2.18
Waterbird Feeding Habitat (WBF)	0.00	Lower	0.00	Lower	0.00	0.00
Waterbird Nesting Habitat (WBN)	0.00	Lower	0.00	Lower	0.00	0.00
Songbird, Raptor, & Mammal Habitat (SBM)	4.89	Moderate	2.50	Lower	4.05	2.50
Pollinator Habitat (POL)	5.09	Moderate	0.00	Lower	4.10	0.00
Native Plant Habitat (PH)	3.80	Lower	3.13	Moderate	4.62	2.72
Public Use & Recognition (PU)			1.97	Lower		1.73
Wetland Sensitivity (Sens)			4.17	Moderate		3.45
Wetland Ecological Condition (EC)			0.60	Lower		4.58
Wetland Stressors (STR) (higher score means more stress)			10.00	Higher		6.28
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	1.88	Lower	4.40	Moderate	3.98	4.45
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	2.23	Lower	9.39	Higher	4.63	8.77
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	3.81	Lower	2.63	Moderate	3.93	1.74
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	1.40	Lower	0.09	Lower	2.72	1.31
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	4.84	Moderate	2.50	Moderate	4.44	2.23
WETLAND CONDITION (EC)			0.60	Lower		4.58
WETLAND RISK (average of Sensitivity & Stressors)			7.08	Higher		4.87

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among the 98 NB calibration wetlands that were assessed previously.

Wetland 9

Size: 0.09 ha
Wetland Classification: formed in a depression due to karst topography
Dominant Wetland Vegetation? Yes

- Trees: none
- Shrubs: none
- Herbs: 40% sensitive fern (FACW), 15% ostrich fern (FACW), 5% bluejoint reed grass (FACW), 1% poison ivy (*Toxicodendron radicans*; FAC)

Primary Wetland Hydrology Indicators: high water table (15 cm), drift deposits, water-stained leaves
Secondary Wetland Hydrology Indicators: none

Soil Profile:

Depth (cm)	Colour (Munsell Color 2009)	%	Redox	%	Texture
0-15	10YR 2/1	100	-	0	Clayey
15-30	2.5Y 4/1	100	-	0	Saturated with inclusions of organic matter
30+	Gley 1 5/5GY		10YR 5/2 (leached)	3	

No restrictive layer encountered

Photo 15: **Representative Photo of Wetland 9** (September 15, 2022)

Photo 16: Soil Profile of Wetland 9 (September 15, 2022)

[1] Percent cover is calculated by each vegetation layer (i.e., trees, shrubs, herbs); therefore, almost always equals >100% total if there are three strata.
[2] OLB = obligate wetland, FACW = facultative wetland, FAC = facultative, FACU = facultative upland, UPL = upland. Hydrophytic vegetation indicator status, based on the Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987).

Assessment Area (AA) Results:

Wetland ID: Glenvale Wetland 9

Date: September 2022

Observer: Chris Kennedy

Latitude & Longitude (decimal degrees): 45.93891, -065.222170

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	8.90	Higher	0.82	Lower	8.57	0.90
Stream Flow Support (SFS)	0.00	Lower	0.00	Lower	0.00	0.00
Water Cooling (WC)	0.00	Lower	0.00	Lower	0.00	0.00
Sediment Retention & Stabilisation (SR)	10.00	Higher	0.67	Lower	10.00	0.41
Phosphorus Retention (PR)	10.00	Higher	0.00	Lower	10.00	0.33
Nitrate Removal & Retention (NR)	10.00	Higher	4.38	Moderate	10.00	5.00
Carbon Sequestration (CS)	3.92	Moderate			6.25	
Organic Nutrient Export (OE)	4.41	Moderate			4.67	
Anadromous Fish Habitat (FA)	0.00	Lower	0.00	Lower	0.00	0.00
Resident Fish Habitat (FR)	0.00	Lower	0.00	Lower	0.00	0.00
Aquatic Invertebrate Habitat (INV)	2.74	Moderate	4.60	Moderate	4.84	3.73
Amphibian & Turtle Habitat (AM)	7.38	Higher	3.39	Moderate	7.20	4.15
Waterbird Feeding Habitat (WBF)	5.39	Moderate	3.33	Moderate	4.28	3.33
Waterbird Nesting Habitat (WBN)	6.10	Higher	2.50	Moderate	5.22	2.50
Songbird, Raptor, & Mammal Habitat (SBM)	6.82	Moderate	2.50	Lower	5.66	2.50
Pollinator Habitat (POL)	7.85	Higher	0.00	Lower	6.32	0.00
Native Plant Habitat (PH)	3.59	Lower	4.60	Moderate	4.53	3.99
Public Use & Recognition (PU)			2.32	Lower		1.98
Wetland Sensitivity (Sens)			4.51	Moderate		3.55
Wetland Ecological Condition (EC)			3.86	Moderate		6.46
Wetland Stressors (STR) (higher score means more stress)			0.56	Lower		2.47
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	0.00	Lower	0.82	Lower	8.57	0.90
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	10.00	Higher	3.03	Lower	9.53	3.46
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	3.10	Lower	3.07	Moderate	3.61	2.48
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	5.58	Moderate	2.62	Lower	5.27	3.07
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	6.97	Moderate	3.48	Moderate	5.91	3.08
WETLAND CONDITION (EC)			3.86	Moderate		6.46
WETLAND RISK (average of Sensitivity & Stressors)			2.53	Lower		3.01

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among the 98 NB calibration wetlands that were assessed previously.

References

Environmental Laboratory. 1987. Corps of Engineers Wetlands Delineation Manual. United States Army Corps of Engineers. Wetlands Research Program Technical Report Y-87-1.

Munsell Color. 2009. Munsell Soil Color Charts. Grand Rapids, MI.

[1] Percent cover is calculated by each vegetation layer (i.e., trees, shrubs, herbs); therefore, almost always equals >100% total if there are three strata.
[2] OLB = obligate wetland, FACW = facultative wetland, FAC = facultative, FACU = facultative upland, UPL = upland. Hydrophytic vegetation indicator status, based on the Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987).

Appendix C

Vegetation Species List

Table C.1: MBBA Results for Square 20LR28 (Stewart et al. 2015)

Common Name	Scientific Name	Conservation Rank[1]	Breeding Status (MBBA)[2]
Canada Goose	*Branta canadensis*	SUB, S5M	**Confirmed:** adult leaving or entering nest sites in circumstances indicating occupied nest
Wood Duck	*Aix sponsa*	S4B	**Possible:** species observed in its breeding season in suitable nesting habitat
American Black Duck	*Anas rubripes*	S5B, S4N	**Possible:** species observed in its breeding season in suitable nesting habitat
Mallard	*Anas platyrhynchos*	S5B, S4N	**Confirmed:** nest with young seen or heard
Ring-necked Duck	*Aythya collaris*	S5B	**Possible:** species observed in its breeding season in suitable nesting habitat
Common Merganser	*Mergus merganser*	S4B, S4N	**Possible:** species observed in its breeding season in suitable nesting habitat
Ruffed Grouse	*Bonasa umbellus*	S5	**Probable:** 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. Use discretion when using this code.
American Bittern	*Botaurus lentiginosus*	S4B, S4S5M	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Bald Eagle	*Haliaeetus leucocephalus*	**NB SARA:** Endangered S4	**Confirmed:** adult leaving or entering nest sites in circumstances indicating occupied nest
Northern Harrier	*Circus hudsonius*	S4B, S4S5M	**Possible:** species observed in its breeding season in suitable nesting habitat
Sharp-shinned Hawk	*Accipiter striatus*	S4B, S5M	**Possible:** species observed in its breeding season in suitable nesting habitat
Sora	*Porzana carolina*	S4B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Killdeer	*Charadrius vociferus*	S3B	**Confirmed:** Distraction display or injury feigning
Wilson's Snipe	*Gallinago delicata*	S3S4B, S5M	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
American Woodcock	*Scolopax minor*	S5B	**Probable:** 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. Use discretion when using this code.

Common Name	Scientific Name	Conservation Rank[1]	Breeding Status (MBBA)[2]
Rock Pigeon	*Columba livia*	SNA	**Probable:** Courtship or display, including interaction between a male and a female or two males, including courtship feeding or copulation
Mourning Dove	*Zenaida macroura*	S5B, S4N	**Probable:** Visiting probable nest site
Barred Owl	*Strix varia*	S5	**Probable:** Pair observed in suitable nesting habitat in nesting season
Ruby-throated Hummingbird	*Archilochus colubris*	S5B	**Probable:** Courtship or display, including interaction between a male and a female or two males, including courtship feeding or copulation
Belted Kingfisher	*Megaceryle alcyon*	S5B	**Probable:** Visiting probable nest site
Yellow-bellied Sapsucker	*Sphyrapicus varius*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Downy Woodpecker	*Dryobates pubescens*	S5	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Hairy Woodpecker	*Dryobates villosus*	S5	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Northern Flicker	*Colaptes auratus*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Pileated Woodpecker	*Dryocopus pileatus*	S5	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
American Kestrel	*Falco sparverius*	S4B, S4S5M	**Possible:** species observed in its breeding season in suitable nesting habitat
Alder Flycatcher	*Empidonax alnorum*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Willow Flycatcher	*Empidonax traillii*	S1S2B	**Probable:** 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. Use discretion when using this code.
Least Flycatcher	*Empidonax minimus*	S4S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season

Common Name	Scientific Name	Conservation Rank[1]	Breeding Status (MBBA)[2]
Eastern Phoebe	*Sayornis phoebe*	S5B	**Confirmed:** nest with young seen or heard
Eastern Kingbird	*Tyrannus tyrannus*	S3S4B	**Possible:** species observed in its breeding season in suitable nesting habitat
Blue-headed Vireo	*Vireo solitarius*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Blue Jay	*Cyanocitta cristata*	S5	**Probable:** Courtship or display, including interaction between a male and a female or two males, including courtship feeding or copulation
American Crow	*Corvus brachyrhynchos*	S5	**Probable:** Visiting probable nest site
Common Raven	*Corvus corax*	S5	**Probable:** 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. Use discretion when using this code.
Tree Swallow	*Tachycineta bicolor*	S4B	**Confirmed:** nest with young seen or heard
Barn Swallow	*Hirundico rustica*	**SARA:** Special Concern **NB SARA:** Threatened S2B	**Confirmed:** Nest containing eggs
Black-capped Chickadee	*Poecile atricapillus*	S5	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Red-breasted Nuthatch	*Sitta canadensis*	S5	**Possible:** species observed in its breeding season in suitable nesting habitat
Brown Creeper	*Certhia americana*	S5	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Golden-crown Kinglet	*Regulus satrapa*	S5	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Ruby-crown Kinglet	*Corthylio calendula*	S4S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Eastern Bluebird	*Sialia sialis*	S4B	**Confirmed:** nest with young seen or heard

Common Name	Scientific Name	Conservation Rank[1]	Breeding Status (MBBA)[2]
Veery	*Catharus fuscescens*	S4B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Hermit Thrush	*Catharus guttatus*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
American Robin	*Turdus migratorius*	S5B	**Confirmed:** nest with young seen or heard
Gray Catbird	*Dumetella carolinensis*	S4B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
European Starling	*Sturnus vulgaris*	SNA	**Confirmed: a**dult leaving or entering nest sites in circumstances indicating occupied nest
Cedar Waxwing	*Bombycilla cedrorum*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Ovenbird	*Seiurus aurocapilla*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Northern Waterthrush	*Parkesia noveboracensis*	S4B, S5M	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Black-and-white Warbler	*Mniotilta varia*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Nashville Warbler	*Leiothlypis ruficapilla*	S4S5B, S5M	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Common Yellowthroat	*Geothlypis trichas*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
American Redstart	*Setophaga ruticilla*	S5B	**Probable:** Pair observed in suitable nesting habitat in nesting season
Northern Parula	*Setophaga americana*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Magnolia Warbler	*Setophaga magnolia*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season

Common Name	Scientific Name	Conservation Rank[1]	Breeding Status (MBBA)[2]
Blackburnian Warbler	*Setophaga fusca*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Yellow Warbler	*Setophaga petechia*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Chestnut-sided Warbler	*Setophaga pensylvanica*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Black-throated Blue Warbler	*Setophaga caerulescens*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Yellow-rumped Warbler	*Setophaga coronata*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Black-throated Green Warbler	*Setophaga virens*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Canada Warbler	*Cardellina canadensis*	**SARA:** Special Concern **NB SARA:** Threatened S3S4B	**Probable:** Pair observed in suitable nesting habitat in nesting season
Chipping Sparrow	*Spizella passerina*	S5B	**Probable:** Courtship or display, including interaction between a male and a female or two males, including courtship feeding or copulation
Song Sparrow	*Melospiza melodia*	S5B	**Probable:** Pair observed in suitable nesting habitat in nesting season
Swamp Sparrow	*Melospiza georgiana*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
White-throated Sparrow	*Zonotrichia albicollis*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Dark-eyed Junco	*Junco hyemalis*	S5	**Possible:** species observed in its breeding season in suitable nesting habitat
Scarlet Tanager	*Piranga olivacea*	S3B	**Possible:** species observed in its breeding season in suitable nesting habitat
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	S3B	**Possible:** species observed in its breeding season in suitable nesting habitat

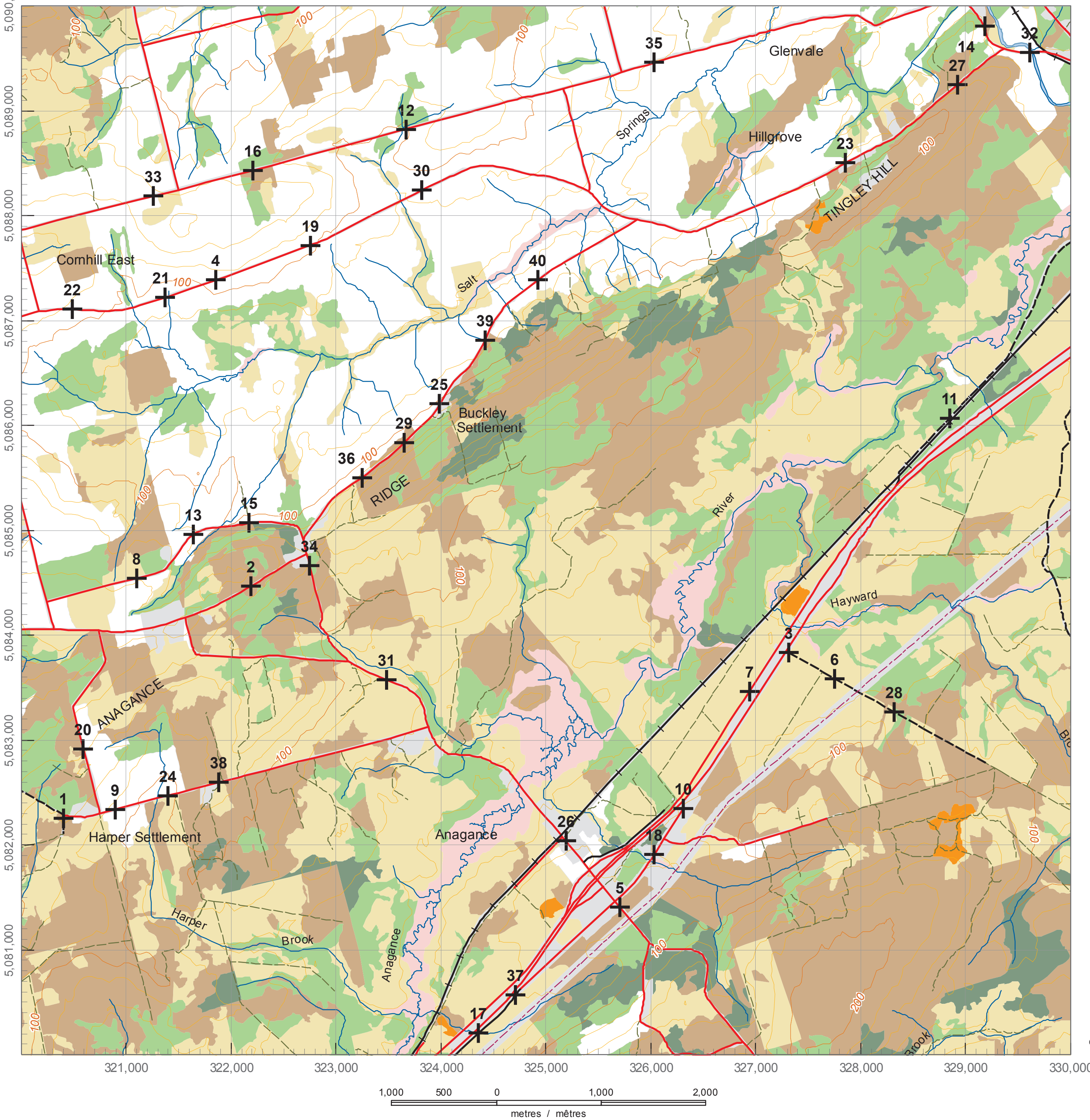
Common Name	Scientific Name	Conservation Rank[1]	Breeding Status (MBBA)[2]
Bobolink	*Dolichonyx oryzivorus*	**SARA:** Special Concern **NB SARA:** Special Concern S3B	**Probable:** Pair observed in suitable nesting habitat in nesting season
Red-winged Blackbird	*Agelaius phoeniceus*	S4B	**Confirmed:** recently fledged young (nidicolous species) or downy young (nidifugous species), including incapable of sustained flight
Common Grackle	*Quiscalus quiscula*	S5B	**Confirmed:** adult carrying food for young
Baltimore Oriole	*Icterus galbula*	S2S3B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Purple Finch	*Haemorhous purpureus*	S4S5B, SUN, S5M	**Probable:** Courtship or display, including interaction between a male and a female or two males, including courtship feeding or copulation
Pine Siskin	*Spinus pinus*	S3	**Probable:** Pair observed in suitable nesting habitat in nesting season
American Goldfinch	*Spinus tristis*	S5	**Probable:** Pair observed in suitable nesting habitat in nesting season
House Sparrow	*Passer domesticus*	SNA	**Confirmed:** nest building or carrying nest materials, for all species except wrens and woodpeckers

Notes:

S1 – Critically imperiled
SU – unrankable (lack of information or conflicting information)
S2 – Imperiled
SNA – Not applicable (i.e., non-native species)
S3 – Vulnerable
S#S# - range rank (addresses any uncertainty about the rank)
S4 – Apparently secure
B – breeding
M – migrant
S5 – Secure
N - nonbreeding

1. Atlantic Canada Conservation Data Centre. 2022. Species Ranks. Retrieved from: http://www.accdc.com/en/ranks.html. Accessed September 2022.
2. Stewart, R.L.M., K.A. Bredin, A.R. Couturier, , A. G. Horn, D. Lepage, S. Makepeace, P. D. Taylor, M.-A. Villard, and R. M. Whittam (eds). 2015. Second Atlas of Breeding Birds of the Maritime Provinces. Bird Studies Canada, Environment Canada, Natural History Society of Prince Edward Island, Nature New Brunswick, New Brunswick Department of Natural Resources, Nova Scotia Bird Society, Nova Scotia Department of Natural Resources, and Prince Edward Island Department of Agriculture and Forestry, Sackville, 528 + 28 pp.

Region/région:13 *New Brunswick* **Anagance** *Nouveau-Brunswick* 20LR28



Maritime Breeding Bird Atlas 2006 - 2010 Atlas des oiseaux nicheurs des Maritimes

Anagance

Region/région: 13 **20LR28**

Roadside Point Count Coordinates/
Coordonnées de points d'écoute
de bordure de route

#	Easting/ Abscisse	Northing/ Ordonnée
1	320,396	5,082,247
2	322,185	5,084,465
3	327,308	5,083,829
4	321,854	5,087,383
5	325,706	5,081,405
6	327,749	5,083,581
7	326,939	5,083,461
8	321,100	5,084,539
9	320,892	5,082,339
10	326,308	5,082,341
11	328,847	5,086,065
12	323,661	5,088,822
13	321,635	5,084,955
14	329,178	5,089,800
15	322,165	5,085,065
16	322,205	5,088,432
17	324,354	5,080,200
18	326,027	5,081,906
19	322,749	5,087,715
20	320,590	5,082,910
21	321,366	5,087,220
22	320,483	5,087,106
23	327,855	5,088,498
24	321,393	5,082,467
25	323,985	5,086,206
26	325,187	5,082,039
27	328,923	5,089,246
28	328,316	5,083,264
29	323,644	5,085,828
30	323,812	5,088,237
31	323,478	5,083,573
32	329,608	5,089,553
33	321,256	5,088,187
34	322,748	5,084,657
35	326,030	5,089,458
36	323,246	5,085,501
37	324,708	5,080,567
38	321,881	5,082,595
39	324,423	5,086,811
40	324,923	5,087,383

Legend/Légende

Highway	Route
Forest Road	Route forestière
Seasonal Road	Chemin saisonnier
Trail	Sentier
Railway, Abandoned Railway or Trail	Voie ferrée, Voie ferrée abandonnée ou sentier
PipeLine	Gazoduc ou conduite d'eau
Transmission Line	Ligne électrique
Contour 20 m	Courbe de niveau 20 m
Contour 100 m (index)	Courbe de niveau 100 m (index)
Stream	Ruisseau
Lake, River, Ocean	Lac, rivière, océan
Open Wetland	Marécage
Bog, Fen or Shrub Wetland	Tourbière ou marécage arbustif
Mature Deciduous Forest	Forêt de feuillus mature
Mature Coniferous Forest	Forêt de conifères mature
Mature Pine Forest	Forêt de pins mature
Young Forest	Jeune fôret
Upland Open Country	Terrain ouvert: agricole, non-boisé
Occupied, Urban, Other	Terrain occupé, zone urbaine, autre
Gravel Pit	Gravière

Cartographic production by New Brunswick Department of Natural Resources, Fish & Wildlife Branch, 2006
Disclaimer
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Production cartographique de la Province du Nouveau-Brunswick, Ministère des Ressources naturelles, Direction de la pêche sportive et de la chasse, 2006
Avis
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6° Universal Transverse Mercator (UTM) Projection; Zone 20, Central Meridian 63° West; North American Datum 1983 (NAD 83)

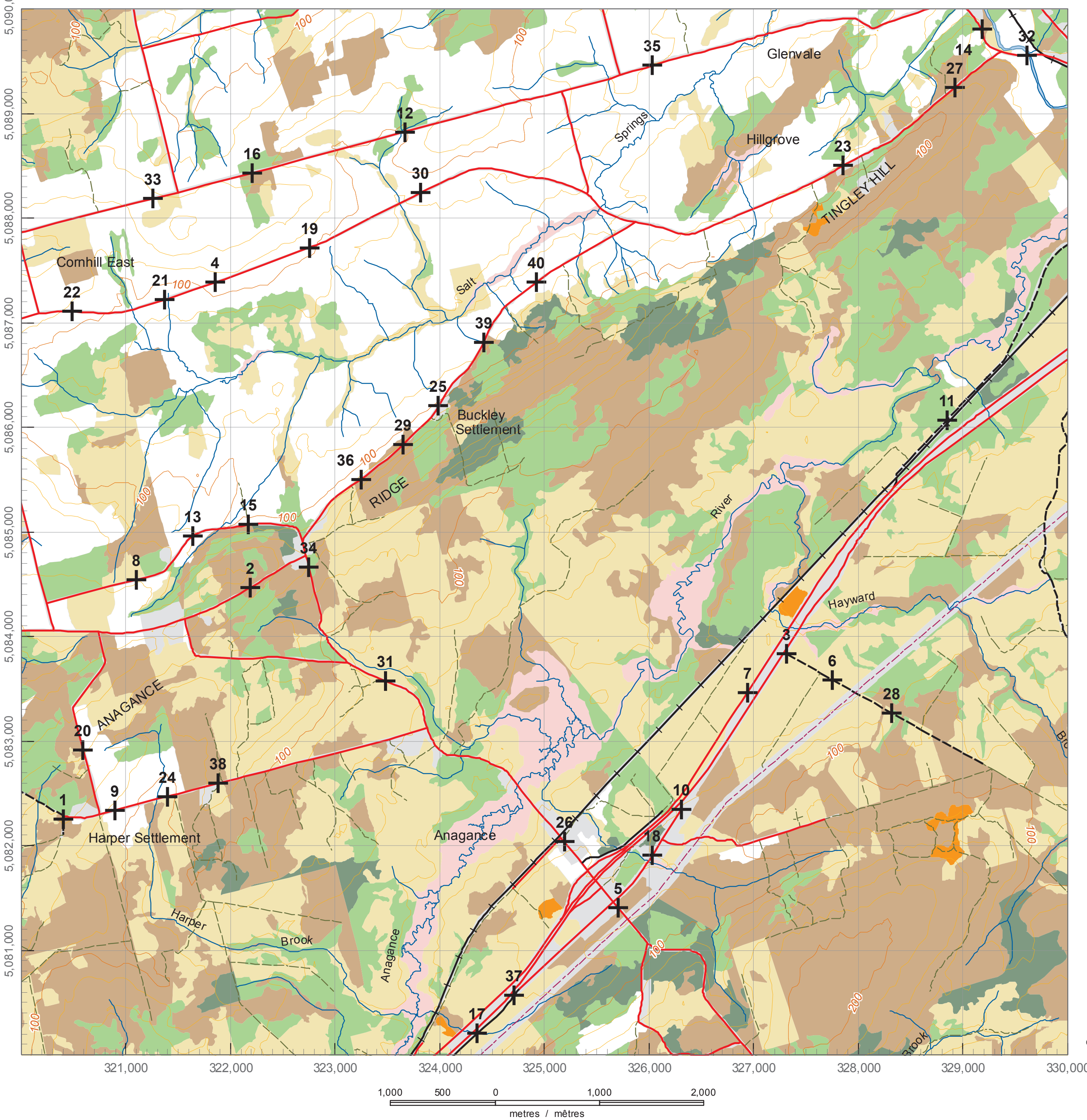
Projection universelle transverse de Mercator (UTM) 6° Zone 20, méridien central 63° ouest; Système de référence géodésique nord-américain 1983 (NAD 83)

Atlas des oiseaux nicheurs des Maritimes / Maritimes Breeding Bird Atlas
New Brunswick Nouveau Brunswick — Natural Resources / Ressources naturelles
Bird Studies Canada / Études d'oiseaux Canada

Appendix D

Site-Specific Maritime Breeding Bird Atlas

Region/région:13 *New Brunswick* **Anagance** *Nouveau-Brunswick* 20LR28



Maritime Breeding Bird Atlas 2006 - 2010 Atlas des oiseaux nicheurs des Maritimes

Anagance

Region/région: 13 20LR28

Roadside Point Count Coordinates/
Coordonnées de points d'écoute
de bordure de route

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37	324,708	5,080,567
38	321,881	5,082,595
39	324,423	5,086,811
40	324,923	5,087,383

Legend/Légende

Highway	Route
Forest Road	Route forestière
Seasonal Road	Chemin saisonnier
Trail	Sentier
Railway, Abandoned Railway or Trail	Voie ferrée, Voie ferrée abandonnée ou sentier
PipeLine £££	Gazoduc ou conduite d'eau
Transmission Line	Ligne électrique
Contour 20 m	Courbe de niveau 20 m
Contour 100 m (index)	Courbe de niveau 100 m (index)
Stream	Ruisseau
Lake, River, Ocean	Lac, rivière, océan
Open Wetland	Marécage
Bog, Fen or Shrub Wetland	Tourbière ou marécage arbustif
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Young Forest	Jeune fôret
Upland Open Country	Terrain ouvert: agricole, non-boisé
Occupied, Urban, Other	Terrain occupé, zone urbaine, autre
Gravel Pit	Gravière

Cartographic production by New Brunswick Department of
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Production cartographique de la Province du Nouveau-Brunswick, Ministère
des Ressources naturelles, Direction de la pêche sportive et de la chasse, 2006
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6° Universal Transverse Mercator (UTM) Projection; Zone 20,
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Projection universelle transverse de Mercator (UTM) 6°
Zone 20, méridien central 63° ouest;
Système de référence géodésique nord-américain 1983 (NAD 83)

Atlas des oiseaux nicheurs des Maritimes
Maritimes Breeding Bird Atlas

New Brunswick Nouveau Brunswick
Natural Resources Ressources naturelles

Bird Studies Canada
Études d'oiseaux Canada

Table D.1: MBBA Results for Square 20LR28 (Stewart et al. 2015)

Common Name	Scientific Name	Conservation Rank[1]	Breeding Status (MBBA)[2]
Canada Goose	*Branta canadensis*	SUB, S5M	**Confirmed:** adult leaving or entering nest sites in circumstances indicating occupied nest
Wood Duck	*Aix sponsa*	S4B	**Possible:** species observed in its breeding season in suitable nesting habitat
American Black Duck	*Anas rubripes*	S5B, S4N	**Possible:** species observed in its breeding season in suitable nesting habitat
Mallard	*Anas platyrhynchos*	S5B, S4N	**Confirmed:** nest with young seen or heard
Ring-necked Duck	*Aythya collaris*	S5B	**Possible:** species observed in its breeding season in suitable nesting habitat
Common Merganser	*Mergus merganser*	S4B, S4N	**Possible:** species observed in its breeding season in suitable nesting habitat
Ruffed Grouse	*Bonasa umbellus*	S5	**Probable:** 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. Use discretion when using this code.
American Bittern	*Botaurus lentiginosus*	S4B, S4S5M	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Bald Eagle	*Haliaeetus leucocephalus*	**NB SARA:** Endangered S4	**Confirmed:** adult leaving or entering nest sites in circumstances indicating occupied nest
Northern Harrier	*Circus hudsonius*	S4B, S4S5M	**Possible:** species observed in its breeding season in suitable nesting habitat
Sharp-shinned Hawk	*Accipiter striatus*	S4B, S5M	**Possible:** species observed in its breeding season in suitable nesting habitat
Sora	*Porzana carolina*	S4B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Killdeer	*Charadrius vociferus*	S3B	**Confirmed:** Distraction display or injury feigning
Wilson's Snipe	*Gallinago delicata*	S3S4B, S5M	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
American Woodcock	*Scolopax minor*	S5B	**Probable:** 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. Use discretion when using this code.

Common Name	Scientific Name	Conservation Rank[1]	Breeding Status (MBBA)[2]
Rock Pigeon	*Columba livia*	SNA	**Probable:** Courtship or display, including interaction between a male and a female or two males, including courtship feeding or copulation
Mourning Dove	*Zenaida macroura*	S5B, S4N	**Probable:** Visiting probable nest site
Barred Owl	*Strix varia*	S5	**Probable:** Pair observed in suitable nesting habitat in nesting season
Ruby-throated Hummingbird	*Archilochus colubris*	S5B	**Probable:** Courtship or display, including interaction between a male and a female or two males, including courtship feeding or copulation
Belted Kingfisher	*Megaceryle alcyon*	S5B	**Probable:** Visiting probable nest site
Yellow-bellied Sapsucker	*Sphyrapicus varius*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Downy Woodpecker	*Dryobates pubescens*	S5	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Hairy Woodpecker	*Dryobates villosus*	S5	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Northern Flicker	*Colaptes auratus*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Pileated Woodpecker	*Dryocopus pileatus*	S5	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
American Kestrel	*Falco sparverius*	S4B, S4S5M	**Possible:** species observed in its breeding season in suitable nesting habitat
Alder Flycatcher	*Empidonax alnorum*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Willow Flycatcher	*Empidonax traillii*	S1S2B	**Probable:** 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. Use discretion when using this code.
Least Flycatcher	*Empidonax minimus*	S4S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season

Common Name	Scientific Name	Conservation Rank[1]	Breeding Status (MBBA)[2]
Eastern Phoebe	*Sayornis phoebe*	S5B	**Confirmed:** nest with young seen or heard
Eastern Kingbird	*Tyrannus tyrannus*	S3S4B	**Possible:** species observed in its breeding season in suitable nesting habitat
Blue-headed Vireo	*Vireo solitarius*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Blue Jay	*Cyanocitta cristata*	S5	**Probable:** Courtship or display, including interaction between a male and a female or two males, including courtship feeding or copulation
American Crow	*Corvus brachyrhynchos*	S5	**Probable:** Visiting probable nest site
Common Raven	*Corvus corax*	S5	**Probable:** 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. Use discretion when using this code.
Tree Swallow	*Tachycineta bicolor*	S4B	**Confirmed:** nest with young seen or heard
Barn Swallow	*Hirundico rustica*	**SARA:** Special Concern **NB SARA:** Threatened S2B	**Confirmed:** Nest containing eggs
Black-capped Chickadee	*Poecile atricapillus*	S5	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Red-breasted Nuthatch	*Sitta canadensis*	S5	**Possible:** species observed in its breeding season in suitable nesting habitat
Brown Creeper	*Certhia americana*	S5	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Golden-crown Kinglet	*Regulus satrapa*	S5	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Ruby-crown Kinglet	*Corthylio calendula*	S4S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Eastern Bluebird	*Sialia sialis*	S4B	**Confirmed:** nest with young seen or heard

Common Name	Scientific Name	Conservation Rank[1]	Breeding Status (MBBA)[2]
Veery	*Catharus fuscescens*	S4B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Hermit Thrush	*Catharus guttatus*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
American Robin	*Turdus migratorius*	S5B	**Confirmed:** nest with young seen or heard
Gray Catbird	*Dumetella carolinensis*	S4B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
European Starling	*Sturnus vulgaris*	SNA	**Confirmed: a**dult leaving or entering nest sites in circumstances indicating occupied nest
Cedar Waxwing	*Bombycilla cedrorum*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Ovenbird	*Seiurus aurocapilla*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Northern Waterthrush	*Parkesia noveboracensis*	S4B, S5M	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Black-and-white Warbler	*Mniotilta varia*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Nashville Warbler	*Leiothlypis ruficapilla*	S4S5B, S5M	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Common Yellowthroat	*Geothlypis trichas*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
American Redstart	*Setophaga ruticilla*	S5B	**Probable:** Pair observed in suitable nesting habitat in nesting season
Northern Parula	*Setophaga americana*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Magnolia Warbler	*Setophaga magnolia*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season

Common Name	Scientific Name	Conservation Rank[1]	Breeding Status (MBBA)[2]
Blackburnian Warbler	*Setophaga fusca*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Yellow Warbler	*Setophaga petechia*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Chestnut-sided Warbler	*Setophaga pensylvanica*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Black-throated Blue Warbler	*Setophaga caerulescens*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Yellow-rumped Warbler	*Setophaga coronata*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Black-throated Green Warbler	*Setophaga virens*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Canada Warbler	*Cardellina canadensis*	**SARA:** Special Concern **NB SARA:** Threatened S3S4B	**Probable:** Pair observed in suitable nesting habitat in nesting season
Chipping Sparrow	*Spizella passerina*	S5B	**Probable:** Courtship or display, including interaction between a male and a female or two males, including courtship feeding or copulation
Song Sparrow	*Melospiza melodia*	S5B	**Probable:** Pair observed in suitable nesting habitat in nesting season
Swamp Sparrow	*Melospiza georgiana*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
White-throated Sparrow	*Zonotrichia albicollis*	S5B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Dark-eyed Junco	*Junco hyemalis*	S5	**Possible:** species observed in its breeding season in suitable nesting habitat
Scarlet Tanager	*Piranga olivacea*	S3B	**Possible:** species observed in its breeding season in suitable nesting habitat
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	S3B	**Possible:** species observed in its breeding season in suitable nesting habitat

Common Name	Scientific Name	Conservation Rank[1]	Breeding Status (MBBA)[2]
Bobolink	*Dolichonyx oryzivorus*	**SARA:** Special Concern **NB SARA:** Special Concern S3B	**Probable:** Pair observed in suitable nesting habitat in nesting season
Red-winged Blackbird	*Agelaius phoeniceus*	S4B	**Confirmed:** recently fledged young (nidicolous species) or downy young (nidifugous species), including incapable of sustained flight
Common Grackle	*Quiscalus quiscula*	S5B	**Confirmed:** adult carrying food for young
Baltimore Oriole	*Icterus galbula*	S2S3B	**Possible:** singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season
Purple Finch	*Haemorhous purpureus*	S4S5B, SUN, S5M	**Probable:** Courtship or display, including interaction between a male and a female or two males, including courtship feeding or copulation
Pine Siskin	*Spinus pinus*	S3	**Probable:** Pair observed in suitable nesting habitat in nesting season
American Goldfinch	*Spinus tristis*	S5	**Probable:** Pair observed in suitable nesting habitat in nesting season
House Sparrow	*Passer domesticus*	SNA	**Confirmed:** nest building or carrying nest materials, for all species except wrens and woodpeckers

Notes:

S1 – Critically imperiled
SU – unrankable (lack of information or conflicting information)
S2 – Imperiled
SNA – Not applicable (i.e., non-native species)
S3 – Vulnerable
S#S# - range rank (addresses any uncertainty about the rank)
S4 – Apparently secure
B – breeding
M – migrant
S5 – Secure
N - nonbreeding

1. Atlantic Canada Conservation Data Centre. 2022. Species Ranks. Retrieved from: http://www.accdc.com/en/ranks.html. Accessed September 2022.
2. Stewart, R.L.M., K.A. Bredin, A.R. Couturier, , A. G. Horn, D. Lepage, S. Makepeace, P. D. Taylor, M.-A. Villard, and R. M. Whittam (eds). 2015. Second Atlas of Breeding Birds of the Maritime Provinces. Bird Studies Canada, Environment Canada, Natural History Society of Prince Edward Island, Nature New Brunswick, New Brunswick Department of Natural Resources, Nova Scotia Bird Society, Nova Scotia Department of Natural Resources, and Prince Edward Island Department of Agriculture and Forestry, Sackville, 528 + 28 pp.

Appendix E

Avian Survey Point Count Data

Point Number	Date & Time	Common Name	Latin Name	Conservation Rank	Approximate Distance (m)	Number of Individuals Observed	Direction	Note
Point Count 1	2022-05-10 6:15 a.m.	Northern Flicker	Colaptes auratus	S5B	100+	1	W/NW	
		Black-capped Chickadee	Poecile atricapillus	S5	0-50	5	N & S	
		White-throated Sparrow	Zonotrichia albicollis	S5B	0-50	1	W	
					50-100	1	SW	
		Blue-headed Vireo	Vireo solitarius	S5B	0-50	1	NW	
		Blue Jay	Cyanocitta cristata	S5	0-50	2	NE	
		American Robin	Turdus migratorius	S5B	0-50	2	NE	
		American Crow	Corvus brachyrhynchos	S5	0-50	4	SW	
					0-50	3	SE	
		American Goldfinch	Spinus tristis	S5	0-50	6	S	
	2022-07-22 5:43 a.m.	Common Raven	Corvus corax	S5	50-100	3		Roosting
					100+	2		
		Red-eyed Vireo	Vireo olivaceus	S5B	50-100	1		Singing
		Dark-eyed Junco	Junco hyemalis	S5	0-50	1		Nesting
		American Goldfinch	Spinus tristis	S5	50-100	2		
					Flyover	2		
		Bald Eagle	Haliaeetus leucocephalus	S4 NB SARA: Endangered	Flyover	1		Adult
		American Crow	Corvus brachyrhynchos	S5	100+	2		
		American Robin	Turdus migratorius	S5B	0-50	1		Fledged
					50-100	2		
		Northern Flicker	Colaptes auratus	S5B	50-100	1		
		Downy Woodpecker	Dryobates pubescens	S5	50-100	1		
		White-breasted Nuthatch	Sitta carolinensis	S4	0-50	1		Singing
		Pileated Woodpecker	Dryocopus pileatus	S5	0-50	1		Pair
		Northern Parula	Setophaga americana	S5B	50-100	1		
		Yellow-bellied Sapsucker	Sphyrapicus varius	S5B	0-50	2		Fledged
		Song Sparrow	Melospiza melodia	S5B	0-50	1		Singing
		Savannah Sparrow	Passerculus sandwichensis	S4S5B, S5M	0-50	1		Singing
Point Count 2	2022-05-10 6:59 a.m.	White-throated Sparrow	Zonotrichia albicollis	S5B	0-50	1	W	
					50-100	2	N & S	
		Eastern Phoebe	Sayornis phoebe	S5B	50-100	1	NE	
		Common Raven	Corvus corax	S5	100+	2	W	
		Northern Flicker	Colaptes auratus	S5B	50-100	2	SE	
		Yellow-bellied Sapsucker	Sphyrapicus varius	S5B	50-100	1	NE	
					100+	1	N	
		Black-capped Chickadee	Poecile atricapillus	S5	0-50	3	S	
		Red-breasted Nuthatch	Sitta canadensis	S5	50-100	1	NE	
					100+	1	SW	
		Song Sparrow	Melospiza melodia	S5B	0-50	1	SW	
		Winter Wren	Troglodytes hiemalis	S5B	0-50	1	SW	
	2022-07-22 6:33 a.m.	American Crow	Corvus brachyrhynchos	S5	100+	2		
		Common Raven	Corvus corax	S5	100+	1		
		Common Yellowthroat	Geothlypis trichas	S5B	50-100	1		
		Ovenbird	Seiurus aurocapilla	S5B	100+	1		
		Eastern Wood-pewee	Contopus virens	S3B SARA: Special Concern NB SARA: Special Concern	50-100	1		Singing
		Black-throated Green Warbler	Setophaga virens	S5B	0-50	1		
		White-throated Sparrow	Zonotrichia albicollis	S5B	0-50	1		
		Red-eyed Vireo	Vireo olivaceus	S5B	0-50	1		Fledged
					50-100	1		
					100+	1		
		Alder Flycatcher	Empidonax alnorum	S5B	100+	1		
		American Robin	Turdus migratorius	S5B	0-50	2		
					50-100	2		
		Hermit Thrush	Catharus guttatus	S5B	50-100	1		
		American Woodcock	Scolopax minor	S5B	0-50	1		Flushed

Point Count 3	2022-05-10 7:44 a.m.	White-throated Sparrow	Zonotrichia albicollis	S5B	0-50	2	SW	
					50-100	1	E	
					100+	1	NE	
		Common Raven	Corvus corax	S5	0-50	2	NW	
					50-100	1	NE	
					100+	1	N	
		Black-capped Chickadee	Poecile atricapillus	S5	0-50	2	N	
					50-100	2	S	
		Blue Jay	Cyanocitta cristata	S5	50-100	2	NE	
		Black-and-white Warbler	Mniotilta varia	S5B	0-50	2	W & NW	
		Yellow Warbler	Setophaga petechia	S5B	0-50	2	W & E	
	2022-07-22 7:48 a.m.	Alder Flycatcher	Empidonax alnorum	S5B	50-100	2		
		Red-eyed Vireo	Vireo olivaceus	S5B	0-50	2		Fledged
		Common Raven	Corvus corax	S5	0-50	1		
		Pileated Woodpecker	Dryocopus pileatus	S5	50-100	1		
		Great Blue Heron	Ardea herodias	S4B	Flyover	1		
		American Goldfinch	Spinus tristis	S5	Flyover	1		
		Song Sparrow	Melospiza melodia	S5B	50-100	1		
		Blue Jay	Cyanocitta cristata	S5	0-50	2		
		Bald Eagle	Haliaeetus leucocephalus	S4 NB SARA: Endangered	50-100	2		Pair
Point Count 4	2022-05-10 8:39 a.m.	Common Raven	Corvus corax	S5	0-50	2	SW	
					50-100	2	NW	
		Black-and-white Warbler	Mniotilta varia	S5B	0-50	1	NW	
		White-throated Sparrow	Zonotrichia albicollis	S5B	0-50	1	S	
					100+	1	SE	
		Black-throated Green Warbler	Setophaga virens	S5B	0-50	1	S	
					50-100	1	S	
					100+	1	NE	
		Yellow-bellied Sapsucker	Sphyrapicus varius	S5B	100+	1	SE	
		Red-breasted Nuthatch	Sitta canadensis	S5	100+	1	E	
		Black-capped Chickadee	Poecile atricapillus	S5	50-100	2	N	
		Blue Jay	Cyanocitta cristata	S5	50-100	1	N	
	2022-07-22 8:08 a.m.	Blue Jay	Cyanocitta cristata	S5	0-50	1		
					50-100	1		
		Common Raven	Corvus corax	S5	100+	3		
		Red-eyed Vireo	Vireo olivaceus	S5B	0-50	1		
					50-100	1		
		American Kestrel	Falco sparverius	S4B, S4S5M	50-100	1		Hunting over cut
		Killdeer	Charadrius vociferus	S3B	50-100	1		Agitated and distracted
		Dark-eyed Junco	Junco hyemalis	S5	NA	1		Likely nest
		Ovenbird	Seiurus aurocapilla	S5B	0-50	1		Singing
		Chestnut-sided Warbler	Setophaga pensylvanica	S5B	0-50	1		Singing
Point Count 5	2022-05-10 9:38 a.m.	Common Raven	Corvus corax	S5	0-50	1	N	
					100+	1	E	
		Brown Creeper	Certhia americana	S5	0-50	1	N	Visual and auditory observations
		Red-breasted Nuthatch	Sitta canadensis	S5	50-100	1	S	
					100+	2	NE & S	
		Black-throated Green Warbler	Setophaga virens	S5B	0-50	1	E	
					50-100	1	NE	
		White-throated Sparrow	Zonotrichia albicollis	S5B	100+	2	SE & E	
	2022-07-22 8:31 a.m.	Black-and-white Warbler	Mniotilta varia	S5B	50-100	1		
		Ovenbird	Seiurus aurocapilla	S5B	0-50	1		
		Black-throated Blue Warbler	Setophaga caerulescens	S5B	50-100	1		Singing
		Eastern Wood-pewee	Contopus virens	S3B SARA: Special Concern NB SARA: Special Concern	50-100	1		
		Black-throated Green Warbler	Setophaga virens	S5B	0-50	1		
		Northern Parula	Setophaga americana	S5B	50-100	1		
		Common Raven	Corvus corax	S5	100+	1		
		American Robin	Turdus migratorius	S5B	0-50	1		
		Yellow-bellied Sapsucker	Sphyrapicus varius	S5B	0-50	1		
		Blue-headed Vireo	Vireo solitarius	S5B	0-50	1		

Point Count 6	2022-07-22 6:09 a.m.	Black-capped Chickadee	Poecile atricapillus	S5	0-50	5		Fledged
		American Robin	Turdus migratorius	S5B	50-100	1		
		American Crow	Corvus brachyrhynchos	S5	50-100	3		
		Common Yellowthroat	Geothlypis trichas	S5B	50-100	1		Singing
		White-throated Sparrow	Zonotrichia albicollis	S5B	50-100	1		Singing
		American Goldfinch	Spinus tristis	S5	Flyover	3		
		Brown Creeper	Certhia americana	S5	50-100	1		Singing
		Red-breasted Nuthatch	Sitta canadensis	S5	0-50	3		Fledged
		Golden-crowned Kinglet	Regulus satrapa	S5	50-100	1		
		Red-eyed Vireo	Vireo olivaceus	S5B	50-100	1		Singing
		Common Raven	Corvus corax	S5	100+	2		
		Black-and-white Warbler	Mniotilta varia	S5B	0-50	2		Fledged
		Savannah Sparrow	Passerculus sandwichensis	S4S5B, S5M	0-50	3		Fledged
Point Count 7	2022-07-22 7:01 a.m.	American Crow	Corvus brachyrhynchos	S5	50-100	1		
					100+	1		
		White-throated Sparrow	Zonotrichia albicollis	S5B	0-50	1		
					50-100	1		
		Bald Eagle	Haliaeetus leucocephalus	S4 NB SARA: Endangered	0-50	1		
		Swainson's Thrush	Catharus ustulatus	S4S5B	50-100	1		
		Song Sparrow	Melospiza melodia	S5B	0-50	1		
					50-100	1		
					100+	1		
		Cedar Waxwing	Bombycilla cedrorum	S5B	Flyover	3		
		Common Raven	Corvus corax	S5	100+	1		
		Purple Finch	Haemorhous purpureus	S4S5B, SUN, S5M	Flyover	2		
		Common Yellowthroat	Geothlypis trichas	S5B	0-50	2		Pair
		Downy Woodpecker	Dryobates pubescens	S5	0-50	1		
		Black-capped Chickadee	Poecile atricapillus	S5	0-50	4		
		American Robin	Turdus migratorius	S5B	50-100	1		
		Ovenbird	Seiurus aurocapilla	S5B	50-100	1		
Point Count 8	2022-07-22 7:23	Common Raven	Corvus corax	S5	50-100	2		
		American Crow	Corvus brachyrhynchos	S5	50-100	3		
		Song Sparrow	Melospiza melodia	S5B	0-50	2		Fledged
					50-100	1		
		Savannah Sparrow	Passerculus sandwichensis	S4S5B, S5M	0-50	1		Agitated
		Cedar Waxwing	Bombycilla cedrorum	S5B	Flyover	2		
		Alder Flycatcher	Empidonax alnorum	S5B	0-50	1		
					50-100	1		
		American Goldfinch	Spinus tristis	S5	0-50	1		
					50-100	1		
		Purple Finch	Haemorhous purpureus	S4S5B, SUN, S5M	Flyover	1		
		Yellow-bellied Sapsucker	Sphyrapicus varius	S5B	50-100	1		
		Northern Parula	Setophaga americana	S5B	50-100	1		
		Black-capped Chickadee	Poecile atricapillus	S5	0-50	3		Fledged
Point Count 9	2022-07-22 9:00 a.m.	Eastern Wood-pewee	Contopus virens	S3B SARA: Special Concern NB SARA: Special Concern	0-50	1		
		Red-eyed Vireo	Vireo olivaceus	S5B	0-50	1		
					50-100	1		
		Black-capped Chickadee	Poecile atricapillus	S5	0-50	2		
		Golden-crowned Kinglet	Regulus satrapa	S5	0-50	1		
		American Robin	Turdus migratorius	S5B	50-100	2		
		Mourning Dove	Zenaida macroura	S5B, S4N	100+	1		
		Northern Flicker	Colaptes auratus	S5B	50-100	1		
		Blue Jay	Cyanocitta cristata	S5	50-100	1		
		Black-throated Green Warbler	Setophaga virens	S5B	100+	1		
Point Count 10	2022-07-22 9:26 a.m.	White-throated Sparrow	Zonotrichia albicollis	S5B	50-100	2		
		Red-eyed Vireo	Vireo olivaceus	S5B	0-50	1		
					50-100	1		
		American Robin	Turdus migratorius	S5B	0-50	1		
		Black-capped Chickadee	Poecile atricapillus	S5	50-100	2		
		Northern Flicker	Colaptes auratus	S5B	100+	1		
		Eastern Bluebird	Sialia sialis	S4B	50-100	2		On wires - pair
		Mourning Dove	Zenaida macroura	S5B, S4N	50-100	1		
		Red-winged Black Bird	Agelaius phoeniceus	S4B	50-100	1		
		Northern Parula	Setophaga americana	S5B	50-100	1		

Notes: highlighted cells indicate a species at risk or species of conservation concern.

Number	Species	10-May-22 PC 1-5	22-Jul-22 PC 1-10	Total
1	Northern Flicker	3	3	6
2	Black-capped Chickadee	14	16	30
3	White-throated Sparrow	13	6	19
4	Blue-headed Vireo	1	1	2
5	Blue Jay	5	5	10
6	American Robin	2	13	15
7	American Crow	7	12	19
8	American Goldfinch	6	10	16
9	Common Raven	12	16	28
10	Red-eyed Vireo	0	13	13
11	Dark-eyed Junco	0	2	2
12	Bald Eagle	0	4	4
13	Downy Woodpecker	0	2	2
14	White-breasted Nuthatch	0	1	1
15	Pileated Woodpecker	0	2	2
16	Northern Parula	0	4	4
17	Yellow-bellied Sapsucker	3	4	7
18	Song Sparrow	1	8	9
19	Savannah Sparrow	0	5	5
20	Eastern Phoebe	1	0	1
21	Red-breasted Nuthatch	6	3	9
22	Winter Wren	1	0	1
23	Common Yellowthroat	0	4	4
24	Ovenbird	0	4	4
25	Eastern Wood-pewee	0	3	3
26	Black-throated Green Warbler	5	3	8
27	Alder Flycatcher	0	5	5
28	Hermit Thrush	0	1	1
29	American Woodcock	0	1	1
30	Black-and-white Warbler	3	3	6
31	Yellow Warbler	2	0	2
32	Great Blue Heron	0	1	1
33	American Kestrel	0	1	1
34	Killdeer	0	1	1
35	Chestnut-sided Warbler	0	1	1
36	Brown Creeper	1	1	2
37	Black-throated Blue Warbler	0	1	1
38	Golden-crowned Kinglet	0	2	2
39	Swainson's Thrush	0	1	1
40	Cedar Waxwing	0	5	5
41	Purple Finch	0	3	3
42	Mourning Dove	0	2	2
43	Eastern Bluebird	0	2	2
44	Red-winged Blackbird	0	1	1
Total		**86**	**176**	**262**

Notes: highlighted cells indicate a species at risk or species of conservation concern.

Appendix F

Indigenous Engagement

June 3, 2022

Via email to:

RE: Early Engagement on Proposed Glenvale Gypsum Development

Kwe,

I am writing to you today on behalf of Hammond River Holdings Limited (HRH). HRH owns and operates the Upham East Gypsum quarry, near Upham, NB and is actively exploring the area for new local gypsum opportunities to supply Atlantic Wallboard Limited in Saint John, NB.

HRH has identified a property with high potential in Glenvale, near Petitcodiac NB (Glenvale). We have previously notified MTI on January 27, 2021 of the potential of this property when we filed our Notice of Planned Work. Exploratory drilling and small excavations have been taking place and testing gypsum rock for product quality is ongoing.

Currently, HRH is highly certain that the gypsum deposits on the Glenvale property are suitable for the production of quality gypsum wallboard products. Our intention is to file an Environmental Impact Assessment (EIA) with the Department of Environment and Local Government in the early fall of 2022.

We would like to extend an offer of early engagement to your community so that HRH can discuss the proposed project with you and understand impacts to Rights prior to filing the EIA.

Please advise at your earliest convenience if you have interest in participating in this process. We look forward to your response and understanding if and how you would like to participate with us.

Wela'lin,

HAMMOND RIVER HOLDINGS, LIMITED

Andrew Willett

Andrew Willett
Director, Aboriginal Relations

Cc: David Irving, Daniel Guest, Chief Sasha Labillois, Chief Terry Richardson, Chief Alvery Paul, Chief George Ginnish, Chief Bill Ward, Chief Breton LeBlanc, Chief Arren Sock, Chief Ken Barlow, Chief Rebecca Knockwood, Dean Vicaire, Kristie Halka-Glazier, Marcy Cloud, Jennifer Coleman, Roy Stewart

Attachment

Figure 1. Locator Map for Glenvale Gypsum in south eastern New Brunswick

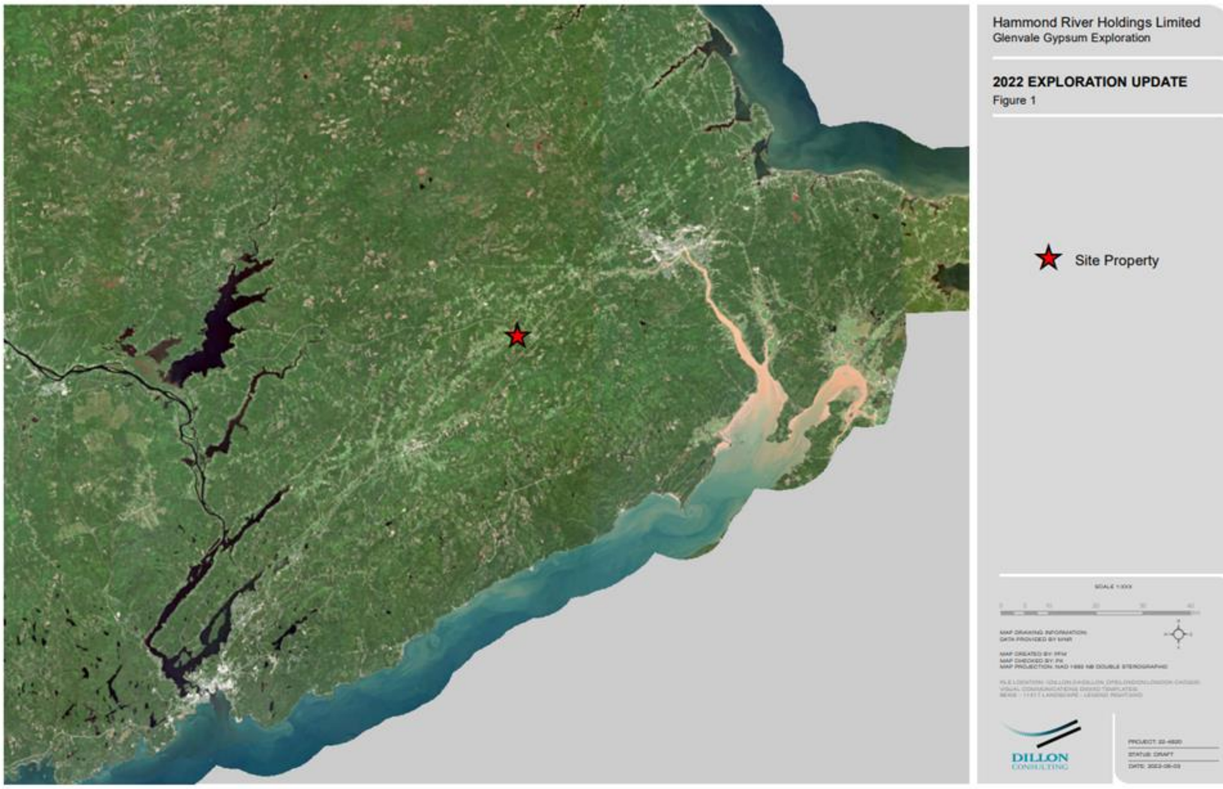

Figure 2. Proposed High Level Site Plan for Glenvale Gypsum