DILLON CONSULTING

HAMMOND RIVER HOLDINGS LIMITED

Environmental Impact Assessment (EIA) Registration

Proposed Upham East Gypsum Quarry Project, Upham, New Brunswick



October 2018 – 18-8346

October 30, 2018

1149 Smythe Street
Suite 200
Fredericton
New Brunswick
Canada
E3B 3H4
Telephone
506.444.8820
Fax
506.444.8821

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: Mr. Paul Vanderlaan, P.Eng.
Director, Environmental Impact Assessment Branch

RE: Environmental Impact Assessment (EIA) Registration: Proposed Upham East Gypsum Quarry Project, Upham, 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 Upham East 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

Denis L. Marquis, M.Sc.E., P.Eng.
Associate, Project Manager

DLM:trw
Enclosure
cc: R. Bruce Eddy

Our file: 18-8346

Table of Contents

1.0 Introduction 1

1.1 Proponent Information 1
1.2 The Undertaking 3
1.2.1 Project Overview (Nature of the Undertaking) 3
1.2.2 What is Gypsum? 5
1.2.3 Purpose/Rationale/Need for the Project 5
1.2.3.1 Alternatives to the Project 6
1.3 Regulatory Context 6
1.3.1 Provincial Legislation 7
1.3.1.1 Environmental Impact Assessment Regulation 7
1.3.1.2 Other Potential Provincial Authorizations, Approvals, Permits, Licenses, and Leases 7
1.3.2 Federal Legislation 8
1.3.2.1 Canadian Environmental Assessment Act, 2012 8
1.3.2.2 Other Potential Federal Authorizations, Approvals, Permits, Licenses, or Leases 10
1.3.3 Other Requirements 10
1.4 Purpose and Organization of this Document 10

2.0 Project Description 12

2.1 Project Location 12
2.1.1 Siting Considerations 14
2.1.2 Property Ownership 14
2.2 Geology of the Upham East Deposit 14
2.2.1 Regional Geology 14
2.2.2 Property Geology – Bedrock 15
2.2.3 Property Geology – Surficial 15
2.2.4 Mineralization 16
2.3 Description of Project Components 16
2.3.1 Open Pit 16
2.3.2 Primary Crusher 18
2.3.3 Gypsum Storage Area 19
2.3.4 Topsoil and Overburden Storage Area 19
2.3.5 Facilities for Pit Dewatering and Runoff Management 19
2.3.6 Truck Scale (Optional) 21

2.3.7 Portable Trailer/Office (Optional) 21
2.3.7.1 Potable Water and Sanitary Sewer 21
2.3.7.2 Electrical Power Supply 21
2.3.8 Security Gate 22
2.3.9 Site Access and Internal Site Roads 22
2.3.10 Preferred Transportation Route 22
2.3.11 Hazardous Materials Use and Storage 22
2.3.12 Mobile Equipment 24
2.4 Description of Project Phases and Activities 24
2.4.1 Construction Phase 24
2.4.1.1 Vegetation Clearing 25
2.4.1.2 Grubbing 25
2.4.1.3 Levelling and Contouring 26
2.4.1.4 Construction of Storage Area 26
2.4.1.5 Removal and Stockpiling of Topsoil and Overburden 26
2.4.1.6 Construction of Perimeter Channels, Drainage Channels, and Settling Pond 26
2.4.1.7 Development of Internal Site Roads, and Paving of Access Road 27
2.4.1.8 Installation of Optional Truck Scale, Optional Portable Trailer/Office, and Security Gate 27
2.4.2 Operation Phase 27
2.4.2.1 Open Pit Operation (Drilling, Blasting, Excavation, Hauling, Crushing) 28
2.4.2.2 On-site Transportation, Storage, Loading, and Transportation to Customers 28
2.4.2.3 Surface Water Management 29
2.4.3 Reclamation and Closure Phase 29
2.4.3.1 Decommissioning 30
2.4.3.2 Reclamation 30
2.4.3.3 Closure 30
2.5 Project Schedule 31
2.6 Workforce 31
2.7 Emissions and Wastes 31
2.7.1 Air Contaminant Emissions 32
2.7.2 Greenhouse Gas (GHG) Emissions 33
2.7.3 Noise and Vibration Emissions 33
2.7.4 Liquid Wastes 34
2.7.5 Pit Dewatering and Surface Runoff 34

2.7.6 Solid Wastes 35
2.8 Alternative Means of Carrying out the Project 35
2.8.1 Alternative Project Locations 35
2.8.2 Alternative Extraction Methods 36
2.8.3 Alternative Locations for Surface Facilities 36
2.8.4 Alternative Water Management Methods 36
2.8.5 Alternative Options for Reclamation and Closure 37
2.8.6 Alternative Transportation Routes 37
2.9 Environmental Planning and Management 38

3.0 Summary of Environmental Setting 40

3.1 Physical Setting 40
3.1.1 Physiography and Geography 40
3.1.2 Topography and Drainage 40
3.1.3 Surficial Geology 40
3.1.4 Bedrock Geology 40
3.2 Biophysical Setting 41
3.2.1 Climate 41
3.2.2 Atmospheric Environment 41
3.2.3 Freshwater Environment 42
3.2.4 Terrestrial Environment 42
3.3 Socioeconomic Setting 44
3.3.1 Demographic Overview 44
3.3.2 Economic Activity 44
3.3.3 Land Use 44
3.3.4 Infrastructure and Services 45

4.0 Environmental Assessment Scope and Methods 46

4.1 Scope of the Assessment 46
4.1.1 Selection of Valued Components 47
4.2 Environmental Assessment Methods 49
4.2.1 Study Boundaries (Temporal and Spatial) 49
4.2.2 Factors to be Considered 50
4.2.3 Scope of Factors to be Considered 50
4.2.4 Environmental Effects Assessment Methods 52

5.0 Environmental Effects Assessment 54

5.1 Project Interactions with the Environment 54
5.1.1 Atmospheric Environment 55
5.1.2 Water Resources 55
5.1.3 Fish and Fish Habitat 55
5.1.4 Vegetation and Wetlands 56
5.1.5 Wildlife and Wildlife Habitat 56
5.1.6 Socioeconomic Environment 56
5.1.7 Heritage Resources 56
5.1.8 Traditional Land and Resource Use 56
5.2 Atmospheric Environment 57
5.2.1 Scope of VC 57
5.2.1.1 Temporal Boundaries 59
5.2.1.2 Spatial Boundaries 60
5.2.1.3 Significance Threshold 60
5.2.2 Existing Conditions 60
5.2.2.1 Climate 60
5.2.2.2 Ambient Air Quality 61
5.2.2.3 Sound Quality 62
5.2.3 Environmental Effects Assessment 65
5.2.3.1 Potential Effects 65
5.2.3.2 Mitigation 65
5.2.3.3 Characterization of Residual Effects 65
5.2.4 Summary 70
5.3 Water Resources 70
5.3.1 Scope of VC 70
5.3.1.1 Temporal Boundaries 71
5.3.1.2 Spatial Boundaries 72
5.3.1.3 Significance Threshold 72
5.3.2 Existing Conditions 72
5.3.2.1 Surface Water Resources 73
5.3.2.2 Groundwater Resources 73
5.3.3 Environmental Effects Assessment 81
5.3.3.1 Potential Effects 81
5.3.3.2 Mitigation 81

5.3.3.3 Characterization of Residual Effects 82
5.3.4 Summary 84
5.4 Fish and Fish Habitat 84
5.4.1 Scope of VC 84
5.4.1.1 Temporal Boundaries 84
5.4.1.2 Spatial Boundaries 85
5.4.1.3 Significance Threshold 85
5.4.2 Existing Conditions 85
5.4.2.1 Regional Setting 86
5.4.2.2 Desktop Analysis 86
5.4.2.3 Field Assessment 87
5.4.3 Environmental Effects Assessment 96
5.4.3.1 Potential Effects 96
5.4.3.2 Mitigation 96
5.4.3.3 Characterization of Residual Effects 97
5.4.4 Summary 99
5.5 Vegetation and Wetlands 99
5.5.1 Scope of VC 99
5.5.1.1 Temporal Boundaries 100
5.5.1.2 Spatial Boundaries 100
5.5.1.3 Significance Threshold 101
5.5.2 Existing Conditions 101
5.5.2.1 Regional Setting 101
5.5.2.2 Desktop Analysis 101
5.5.2.3 Wetland Determination, Delineation, and Functional Assessment 102
5.5.3 Environmental Effects Assessment 118
5.5.3.1 Potential Effects 118
5.5.3.2 Mitigation 119
5.5.3.3 Characterization of Residual Effects 120
5.5.4 Summary 121
5.6 Wildlife and Wildlife Habitat 121
5.6.1 Scope of VC 121
5.6.1.1 Temporal Boundaries 122
5.6.1.2 Spatial Boundaries 123
5.6.1.3 Significance Threshold 123

5.6.2 Existing Conditions 123
5.6.2.1 Resident and Migratory Birds 123
5.6.2.2 Mammals 129
5.6.2.3 Invertebrates 129
5.6.2.4 Herpetiles 130
5.6.2.5 Environmentally Sensitive Areas 130
5.6.3 Environmental Effects Assessment 132
5.6.3.1 Potential Effects 132
5.6.3.2 Mitigation 134
5.6.3.3 Characterization of Residual Effects 135
5.6.4 Summary 135
5.7 Socioeconomic Environment 136
5.7.1 Scope of VC 136
5.7.1.1 Temporal Boundaries 136
5.7.1.2 Spatial Boundaries 137
5.7.1.3 Significance Threshold 137
5.7.2 Existing Conditions 137
5.7.2.1 Land and Resource Use 137
5.7.2.2 Employment and Economy 139
5.7.3 Environmental Effects Assessment 142
5.7.3.1 Potential Effects 142
5.7.3.2 Mitigation 144
5.7.3.3 Characterization of Residual Effects 145
5.7.4 Summary 147
5.8 Heritage Resources 148
5.8.1 Scope of VC 148
5.8.1.1 Temporal Boundaries 149
5.8.1.2 Spatial Boundaries 149
5.8.1.3 Significance Threshold 149
5.8.2 Existing Conditions 150
5.8.2.1 Archeological Impact Assessment Preliminary Investigation Methods 150
5.8.2.2 Potential for Heritage Resources within the PDA – Preliminary Characterization 151
5.8.3 Environmental Effects Assessment 152
5.8.3.1 Potential Effects 152
5.8.3.2 Mitigation 152

5.8.3.3 Characterization of Residual Effects 153
5.8.4 Summary 154
5.9 Traditional Land and Resource Use 154
5.9.1 Scope of VC 154
5.9.1.1 Temporal Boundaries 155
5.9.1.2 Spatial Boundaries 155
5.9.1.3 Significance Threshold 155
5.9.2 Existing Conditions 157
5.9.2.1 Project Context 157
5.9.2.2 First Nation Community Context 158
5.9.2.3 Population Demographics 158
5.9.2.4 Current Use in the PDA and LAA 160
5.9.2.5 Traditional Resources in the PDA, and Traditional Use Perspective of those Resources 161
5.9.3 Environmental Effects Assessment 162
5.9.3.1 Potential Effects 162
5.9.3.2 Mitigation 163
5.9.3.3 Characterization of Residual Effects 163
5.9.4 Summary 165

6.0 **Effects of the Environment on the Project** **167**

6.1 Scope 167
6.1.1 Temporal Boundaries 167
6.1.2 Spatial Boundaries 167
6.1.3 Significance Threshold 168
6.2 Existing Conditions 168
6.2.1 Climate and Climate Change 168
6.2.2 Severe Weather Events 169
6.2.3 Seismicity 170
6.2.4 Forest Fires 171
6.3 Effects Assessment 172
6.3.1 Potential Effects 172
6.3.2 Mitigation 174
6.3.3 Characterization of Residual Effects 176
6.4 Summary 176

7.0 Accidents, Malfunctions, and Unplanned Events 178

7.1 Approach 178
7.2 Description of Potential Credible Accidents, Malfunctions, and Unplanned Events 178
7.3 Potential Interactions between Accidents, Malfunctions, and Unplanned Events and Related Valued Components 179
7.4 Assessment of Potential Environmental Effects from Accidents, Malfunctions, and Unplanned Events 180
7.4.1 Slope Failure 181
7.4.1.1 Mitigation 181
7.4.1.2 Potential Residual Environmental Effects 181
7.4.2 Failure of Erosion and Sediment Control Measures 181
7.4.2.1 Mitigation 182
7.4.2.2 Potential Residual Environmental Effects 182
7.4.3 Uncontrolled Explosion 183
7.4.3.1 Mitigation 183
7.4.3.2 Potential Residual Environmental Effects 184
7.4.4 Vehicle Accident 184
7.4.4.1 Mitigation 184
7.4.4.2 Potential Residual Environmental Effects 185
7.4.5 Accidental Release of Hazardous Materials 185
7.4.5.1 Mitigation 186
7.4.5.2 Potential Residual Environmental Effects 187
7.4.6 Discovery of a Heritage Resource 187
7.4.6.1 Mitigation and Response 187
7.4.6.2 Potential Residual Environmental Effects 188
7.5 Summary 188

8.0 Summary of Residual Effects and Mitigation 190

8.1 Overall Summary 190

9.0 Aboriginal Consultation 200

9.1 Overall Approach 200
9.2 Engagement Activities Conducted 202
9.3 Key Issues Identification and Management 202
9.4 Summary Report 202

10.0 Public and Stakeholder Consultation 204

10.1 Objectives and Overall Approach 204
10.2 Engagement Activities Conducted 205
10.3 Key Issues Identification and Management 206
10.4 Summary Report 206

11.0 Other Information 207

11.1 Project-Related Documents 207
11.2 Funding 207
11.3 Signature 207

12.0 Summary and Conclusion 208

13.0 Closing 210

14.0 References 211

14.1 Literature Cited and Internet Sites 211
14.2 Personal Communications 217

Figures

Figure 1.1.1: Project Location 2
Figure 1.2.1: Site Location Plan 4
Figure 2.1.1: Subject and Neighbouring Properties 13
Figure 2.3.1: Conceptual Site Layout Plan 17
Figure 2.3.2: Preferred Transportation Route 23
Figure 3.2.1: Hammond River Watershed and Sub-catchments 43
Figure 5.2.1: Noise Monitoring Locations 64
Figure 5.3.1: Domestic Well Locations 75
Figure 5.3.2: Groundwater Chemistry Trilinear Piper Plot 80
Figure 5.4.1: Fish Habitat 88
Figure 5.5.1: Wetlands 108
Figure 5.6.1: Incidental Wildlife Observations 131
Figure 5.7.1: Regional Service Commission 8 Boundaries 140
Figure 5.7.2: Land Use in the Local Assessment Area 141
Figure 5.9.1: Spatial Boundaries for Traditional Land and Resource Use 156

Figure 5.9.2: First Nations Communities in New Brunswick 159
Figure 6.2.1: Natural Resources Canada Fire Weather Index 171

Tables

Table 1.1.1: Proponent Information 1
Table 1.3.1: Other Potential Provincial Authorizations, Approvals, Permits, Licenses, or Leases 8
Table 1.3.2: Other Potential Federal Authorizations, Approvals, Permits, Licenses, or Leases 10
Table 2.3.1: On-site Mobile Equipment Use During Construction and Operation 24
Table 4.1.1: Project Phases and Activities to be Carried Forward within the EIA 47
Table 4.1.2: Valued Components for the Project, and Rationale for their Selection 48
Table 4.2.1: Scope of Factors to be Considered and Approach to the Assessment for each Valued Component 51
Table 5.1.1: Potential Interactions between the Project and the Environment 55
Table 5.2.1: Ambient Air Quality Standards and Objectives 59
Table 5.2.2: Climate Normals, Saint John (Saint John Airport), New Brunswick (1981-2010) 61
Table 5.2.3: Ambient Monitoring Data – Forest Hills, Saint John, New Brunswick, 2014-2016 Maximums 62
Table 5.2.4: Sound Monitoring Results – September 24-25, 2018 63
Table 5.2.5: Total Emissions Associated with Construction (Over an Assumed 6 Month Period) 66
Table 5.2.6: Noise Modelling Results – Construction Phase 67
Table 5.2.7: Annual Emissions Associated with Operation 67
Table 5.2.8: Noise Modelling Results – Operation Phase 69
Table 5.3.1: Well Construction Details For 12 Wells Within Approximately 2 km of the Project (NBDELG 2018b) 74
Table 5.3.2: Observed Stratigraphy for 12 Wells Within Approximately 2 km of the Project (NBDELG 2018b) 76
Table 5.3.3: Water Bearing Zones for 12 Wells Within Approximately 2 km of the Project (NBDELG 2018b) 77
Table 5.3.4: General Chemistry and Trace Metals – OWLS Survey Analytical Data 79
Table 5.4.1: Summary of Watercourse Characteristics 90
Table 5.4.2: Summary of In-situ and Laboratory Water Quality Results 93
Table 5.5.1: Benefits of Wetland Functions Scored by WESP-AC 104
Table 5.5.2: Summary of Wetland Findings 106

Table 5.6.1: Bird Species At Risk Historically Observed within 5 km of the Project (AC CDC 2018) 125
Table 5.7.1: Age Group Distribution for Upham Parish for 2011 and 2016 142
Table 5.9.1: Population of Indigenous Band Members On-Reserve (2016) 159
Table 7.3.1: Potential Interactions of Accidents, Malfunctions, and Unplanned Events with Valued Components 180
Table 8.1.1: Summary of Residual Effects and Mitigation 191
Table 9.3.1: Sample First Nations Consultation Log 202
Table 10.3.1: Sample Public Consultation Log 206

Appendices

A AC CDC Report
B Wetland Delineation and Functional Assessment Data
C Vegetation Species Lists
D Site Specific Maritime Breeding Bird Atlas
E First Nation Engagement – Information Package
F Public Consultation – Information Package

1.0 Introduction

This document is an environmental impact assessment (EIA) registration for the proposed Upham East Gypsum Quarry Project (the Project) proposed by Hammond River Holdings Limited (Hammond River Holdings) in the community of Upham, Kings 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 item (a) 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"*]. As such, the Project must be registered under Section 5(1) of the EIA Regulation, and at minimum a determination review will be conducted.

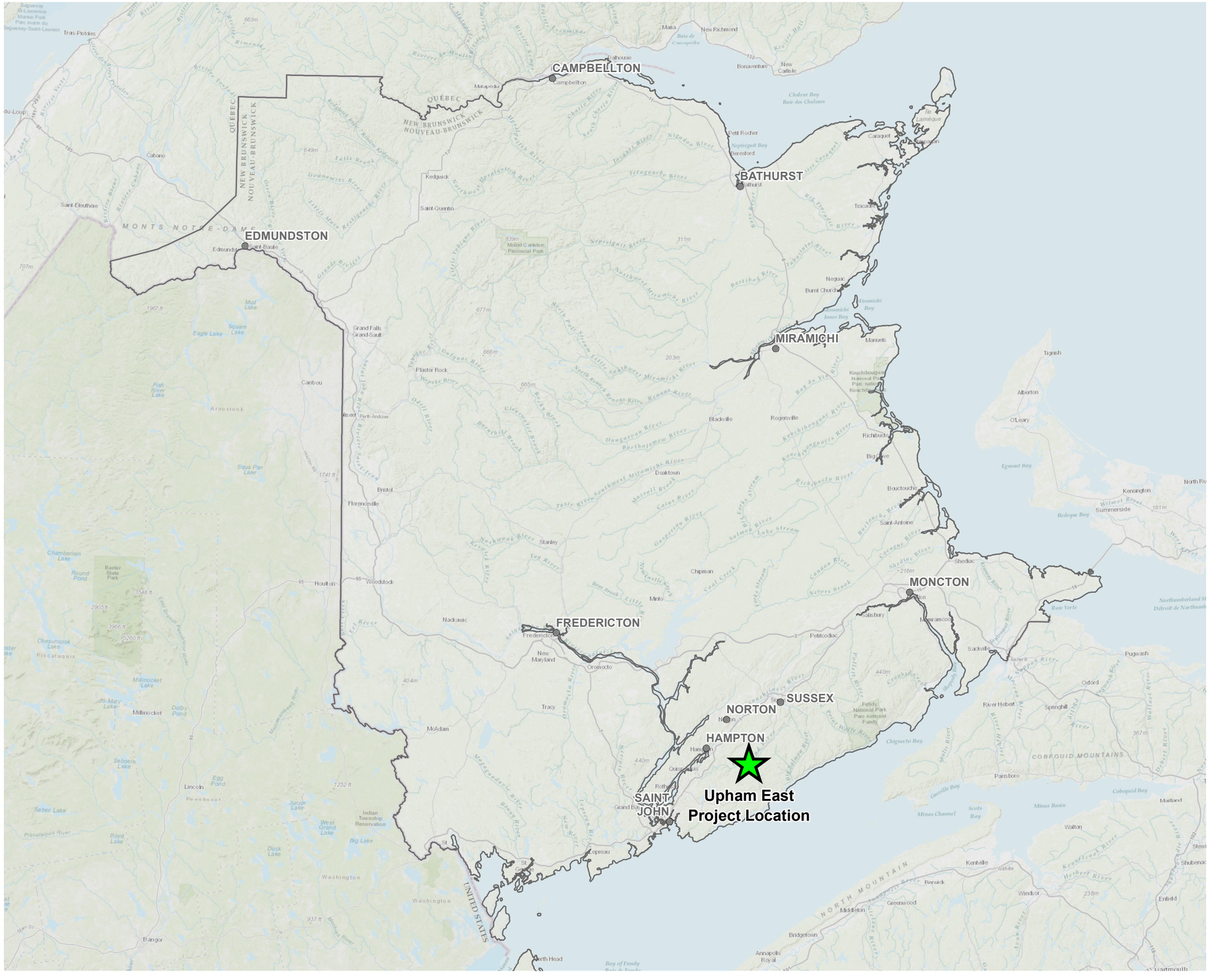
This EIA Registration document is submitted to the New Brunswick Department of Environment and Local Government (NBDELG) under Section 5(2) of the New Brunswick *Environmental Impact Assessment Regulation* 87-83 of the *Clean Environment Act*. It has been prepared by Dillon Consulting Limited (Dillon) 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 "Upham East 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:	Upham East Gypsum Quarry Project
Name of Proponent:	Hammond River Holdings Limited
Mailing Address of Proponent:	210-65 Regent Street Fredericton, NB E3B 7H8
Proponent's Contact Person for the purposes of this EIA Registration:	R. Bruce Eddy Tel: 506.632.4494 Email: info@hammondriverholdings.com Website: www.hammondriverholdings.com (link available after November 13, 2018)
Environmental Consultant that led the preparation of this EIA Registration:	Denis L. Marquis, M.Sc.E., P.Eng. Associate, Project Manager Dillon Consulting Limited 1149 Smythe Street, Suite 200 Fredericton, NB E3B 3H4 Tel.: 506.476.8276 Email: uphameastproject@gmail.com



HAMMOND RIVER HOLDINGS LIMITED
PROPOSED UPHAM EAST GYPSUM QUARRY

PROJECT LOCATION
FIGURE 1.1.1

- PROVINCIAL BOUNDARY
- PROJECT LOCATION
- MAJOR CITIES AND TOWNS

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: BQS
MAP REVISED BY: JH
MAP CHECKED BY: DM
MAP PROJECTION: NAD_1983_CSRS_New_Brunswick_Stereographic

FILE LOCATION: \\DILLON.CA\DILLON_DFS\FREDERICTON\FREDERICTON CAD\CAD\GIS\188346 UPHAM GYPSUM QUARRY\MXD

DILLON CONSULTING

PROJECT: 18-8346
STATUS: FINAL
DATE: OCT 2018

1.2 The Undertaking

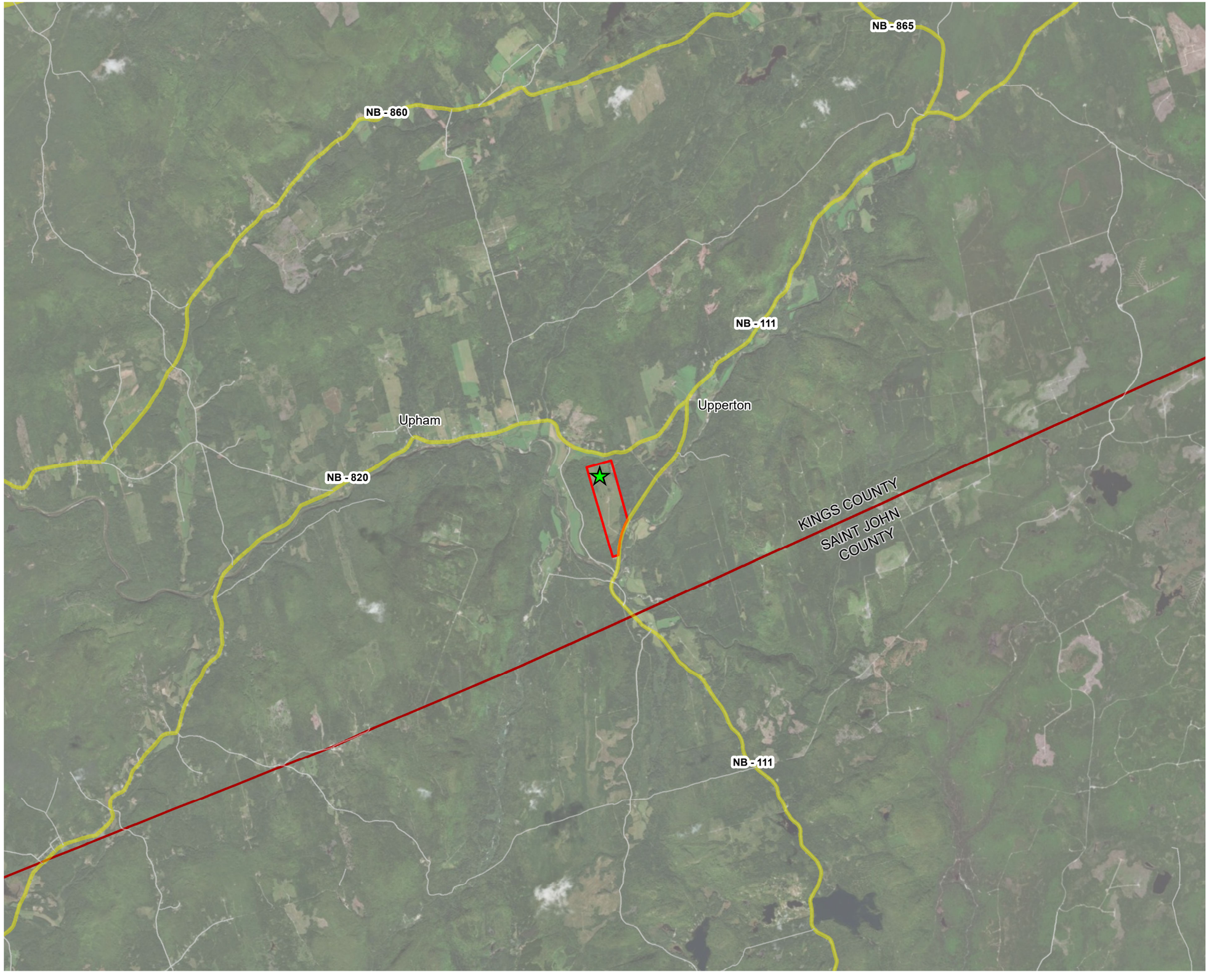
A high-level description of the undertaking is provided in this section.

1.2.1 Project Overview (Nature of the Undertaking)

For some time, Hammond River Holdings has been conducting an exploration program for the potential quarrying of gypsum for use by other parties as a raw material in the production of gypsum wallboard. Through this exploration program, the Upham East property (**Figure 1.2.1**) has been identified as holding a reserve of approximately 2.5 million metric tonnes of suitable quality gypsum rock located near ground surface 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 approximately 250,000 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;
- possible conveying and/or stacking equipment at the storage area, to stockpile crushed gypsum;
- 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 (including from pit dewatering) to allow for settling of suspended sediments prior to release to the natural environment;
- an optional truck scale, for weighing trucks entering and leaving the property;
- a security gate, for controlling access to the site;
- an optional portable trailer, to serve as a site office/lunch room; and,
- an existing access road from the provincial Route 111 to the site, and internal roads between various components of the Project.



HAMMOND RIVER HOLDINGS LIMITED
PROPOSED UPHAM EAST GYPSUM QUARRY

SITE LOCATION PLAN
FIGURE 1.2.1

SITE LOCATION
PROJECT DEVELOPMENT AREA
COUNTIES



0 0.25 0.5 1 Kilometers

SCALE 1:65,000

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: BQS
MAP REVIEWED BY: CS
MAP CHECKED BY: DM
MAP PROJECTION: NAD_1983_CSRS_New_Brunswick_Stereographic

DILLON CONSULTING

PROJECT: 18-8346
STATUS: FINAL
DATE: OCT 2018

Blasting will be conducted by a licensed explosives contractor who will either bring the required amount of explosives to the site, or store them in an on-site explosives magazine (managed by the contractor). Transport trucks will be used to transport gypsum to customers.

Construction has been assumed to take approximately 6 months beginning in the second quarter of 2019, with operation (production) beginning in approximately the fourth quarter of 2019 for an estimated 10 years of production, subject to further confirmation of the resource.

Once overburden materials are removed and stockpiled, gypsum rock will be blasted and/or excavated in the open pit, crushed to a manageable size for transport using portable crushing equipment on-site, temporarily stored on-site in a designated storage area pending transportation, and transported to future customers for use in the production of gypsum wallboard.

Due to the nature of the gypsum deposit as currently understood, the Project has an estimated lifespan of approximately 10 years. 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 Upham East 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 What is Gypsum?

Gypsum is a soft, inert, sulphate-based mineral. It can appear as a white or grey coloured rock. It can take two forms:

- Natural gypsum, which is quarried as a naturally-occurring mineral; or,
- Synthetic gypsum, which is a by-product of flue gas desulphurization in fossil fuel-fired power plants.

Gypsum that is heated at low temperatures is called calcined gypsum. Uncalcined, or raw, gypsum is used as: an additive in the cement industry; a raw material for construction; as a fertilizer; and a filler for paints, toothpaste and shampoo. Calcined gypsum is heavily used in the wallboard industry.

The mineral formula for gypsum is calcium sulphate dehydrate, or $CaSO_4 \bullet 2H_2O$.

1.2.3 Purpose/Rationale/Need for the Project

The Project is intended to supply natural gypsum rock for the production of gypsum wallboard at New Brunswick facilities.

As noted above, wallboard production can use either natural gypsum or synthetic gypsum as a raw material. Some New Brunswick wallboard manufacturing facilities began operations using primarily synthetic gypsum originating from the nearby Coleson Cove Generating Station west of Saint John; however, with a decrease in the use of Coleson Cove to supply electricity in New Brunswick occurring over time due to fuel costs and environmental factors, the local supply of synthetic gypsum has become quite limited. The only other power plant that produces synthetic gypsum in New Brunswick is the

Belledune Generating Station in northern New Brunswick, although the available supply is insufficient to meet local market needs and the transportation costs from Belledune are not economically feasible. With a planned phase-out of coal use for power generation by 2030, the supply of synthetic gypsum is expected to become even more limited in the coming years.

In response to this decreasing supply, the local market has been gradually replacing synthetic gypsum with natural gypsum imported via rail from the National Gypsum quarry in Milford, Nova Scotia, for use as a raw material in wallboard production. Natural gypsum represents the majority of raw material supply to the local wallboard market, supplemented by the opportunistic use of synthetic gypsum when available.

Reductions in the available supply of synthetic gypsum, coupled with recent North American wallboard industry growth of 5.6%, has increased overall market demand for natural gypsum. There is no natural gypsum quarrying in New Brunswick currently. The nearest operating gypsum quarry is the National Gypsum quarry in Milford, Nova Scotia. Other organizations have identified potential Nova Scotia-based gypsum quarries (such as Knauf and Nova Construction), in response to the growing market demand. Despite the increasing supply regionally, the market demand is still outpacing the local supply in a manner that threatens the viability of the local wallboard business. In addition, securing a long-term supply of this important raw material is imperative to the long-term success of the local wallboard production industry.

As such, the Project is intended to supply gypsum for New Brunswick-based wallboard manufacturing facilities, thereby ensuring a local, long-term, and secure gypsum supply as well as offsetting escalating transportation costs.

1.2.3.1 Alternatives to the Project

The Project is intended to provide a technically and economically feasible source of gypsum for producing gypsum wallboard at New Brunswick-based manufacturing facilities. Though there are technically feasible alternatives to the Project which could include securing other, more distant, sources of synthetic gypsum elsewhere in New Brunswick or importing natural gypsum from other jurisdictions, those alternatives would be cost-prohibitive (or, in the case of synthetic gypsum, of limited and decreasing supply), and thus would not be economically feasible. 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 item (a) of Schedule A of the EIA Regulation, as follows:

> *"(a) all commercial extraction or processing of a mineral as defined in the Mining Act."*

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 Local Government (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/her 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, and Leases

In addition to the provincial EIA review of the Project, other provincial authorizations, approvals, permits, licenses, and 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 Energy and Resource Development (NBDERD)
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 environmental assessment (EA) under the *Canadian Environmental Assessment Act, 2012* (as discussed below). However, some federal permits, approvals, authorizations, or licenses may be required from one or more federal government agencies. The regulatory framework that is believed to apply to the Project is discussed below.

1.3.2.1 Canadian Environmental Assessment Act, 2012

The requirements for federal EA are defined by the *Canadian Environmental Assessment Act, 2012* (CEAA 2012). CEAA 2012 applies to "designated projects," which are physical activities listed under the

Regulations Designating Physical Activities under CEAA 2012, as well as to those activities being carried out on federal land.

The *Regulations Designating Physical Activities* identify 48 physical activities that require an EA under CEAA 2012. Mining and quarrying activities are addressed as items 16 and 17 of these Regulations, as follows:

> *"16 The construction, operation, decommissioning and abandonment of a new*
>
> *(a) metal mine, other than a rare earth element mine or gold mine, with an ore production capacity of 3 000 t/day or more;*
>
> *(b) metal mill with an ore input capacity of 4 000 t/day or more;*
>
> *(c) rare earth element mine or gold mine, other than a placer mine, with an ore production capacity of 600 t/day or more;*
>
> *(d) coal mine with a coal production capacity of 3 000 t/day or more;*
>
> *(e) diamond mine with an ore production capacity of 3 000 t/day or more;*
>
> *(f) apatite mine with an ore production capacity of 3 000 t/day or more; or*
>
> *(g) stone quarry or sand or gravel pit, with a production capacity of 3 500 000 t/year or more.*
>
> *17 The expansion of an existing*
>
> *(a) metal mine, other than a rare earth element mine or gold mine, that would result in an increase in the area of mine operations of 50% or more and a total ore production capacity of 3 000 t/day or more;*
>
> *(b) metal mill that would result in an increase in the area of mine operations of 50% or more and a total ore input capacity of 4 000 t/day or more;*
>
> *(c) rare earth element mine or gold mine, other than a placer mine, that would result in an increase in the area of mine operations of 50% or more and a total ore production capacity of 600 t/day or more;*
>
> *(d) coal mine that would result in an increase in the area of mine operations of 50% or more and a total coal production capacity of 3 000 t/day or more;*
>
> *(e) diamond mine that would result in an increase in the area of mine operations of 50% or more and a total ore production capacity of 3 000 t/day or more;*
>
> *(f) apatite mine that would result in an increase in the area of mine operations of 50% or more and a total ore production capacity of 3 000 t/day or more; or*
>
> *(g) stone quarry or sand or gravel pit that would result in an increase in the area of mine operations of 50% or more and a total production capacity of 3 500 000 t/year or more."*

Since the Project is not a mine, a stone quarry, or a sand or gravel pit as defined above, it is not a designated project under CEAA 2012. 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 EA under CEAA 2012.

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

There are few federal authorizations, approvals, permits, licenses, and leases that are believed to be required for the Project. The potential federal authorizations, approvals, permits, licenses, and 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 Serious Harm to Fish	For temporary or permanent alterations to fish habitat (likely required)	*Fisheries Act*	Department of Fisheries and Oceans Canada (DFO)

In addition to the above, should Hammond River Holdings decide to proceed with installing an on-site explosives magazine (to be managed by a licensed explosives contractor), a magazine license under the *Explosives Act* would be required; the need for this license, or for other permits, approvals, or authorizations will be confirmed as part of the permitting phase of the Project (following the EIA review).

1.3.3 Other Requirements

Other requirements may include a development planning approval under the New Brunswick *Community Planning Act*, as administered by Regional Service Commission 8 (RSC8). There may also be local planning requirements for excavation activities, to be confirmed in consultation with RSC8 and/or the local service district of Upham.

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 14 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 mine 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 all Project phases;
- 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 9 summarizes the residual environmental effects of the Project, and planned mitigation;
- Chapter 10 describes planned Aboriginal consultation activities in respect of the Project;
- Chapter 11 provides a description of planned public and stakeholder engagement activities in respect of the Project;
- Chapter 12 provides a summary of the EIA Registration, and resulting conclusions;
- Chapter 13 provides closing remarks; and,
- Chapter 14 provides the references and personal communications 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 Upham, in Kings County, New Brunswick. The parcel identifier (PID) of the property, as referenced by Service New Brunswick, is PID No. 00149013. The geographic centre of the property is at coordinates N 7386845.13 and E 2561169.61. The property (**Figure 1.2.1**) has an area of approximately 61.81 hectares (ha), and is easily accessible via the existing provincial highway network via Route 111 to the southeast of the Project site (where the current site access road is located).

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 61.81 ha (i.e., conservatively assumed to be the entirety of PID No. 00149013) that includes the open pit and all related surface facilities located on the property. The PDA consists of a near-rectangular-shaped property with approximate dimensions of 425 m wide by 1,450 m deep. The PDA is the area represented by the physical Project footprint. The subject and neighbouring properties are shown on **Figure 2.1.1.**

The nearest major watercourse to the property is the Hammond River, which surrounds the Project site in a "U" shape to the west, south and east of the site. The distance between the Project site boundaries and the Hammond River is approximately 600 m to the west, 250 m from the south, and 100 m or more to the east of the site.



HAMMOND RIVER HOLDINGS LIMITED
PROPOSED UPHAM EAST GYPSUM QUARRY

SUBJECT AND NEIGHBOURING PROPERTIES
FIGURE 2.1.1

- SITE LOCATION
- WATERCOURSE
- PROPERTY BOUNDARIES



SCALE 1:10,143
0 125 250 500 m

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: BQS
MAP REVISED BY: JH
MAP CHECKED BY: DM
MAP PROJECTION: NAD_1983_CSRS_New_Brunswick_Stereographic

FILE LOCATION: \\DILLON.CA\DILLON_DFS\FREDERICTON\FREDERICTON CAD\CAD\GIS\188346 UPHAM GYPSUM QUARRY\MXD

DILLON CONSULTING

PROJECT: 18-8346
STATUS: FINAL
DATE: OCT 2018

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 Energy and Resource Development (NBDERD), 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, proximity to major roads and infrastructure, proximity to receiving markets, property ownership, and overall potential development. The Upham East 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 2018 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 based on the drilling results.

As mentioned previously, the Upham East Gypsum Quarry Project is one of several other potential gypsum deposits that may be explored for future consideration by Hammond River Holdings. Although those other potential gypsum deposits may constitute a future phase of the Project, the scope of this EIA Registration document is limited to the Project as currently proposed at the Upham East 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.

2.1.2 Property Ownership

The subject property is owned by Hammond River Holdings Limited.

2.2 Geology of the Upham East Deposit

The geology of the Upham East deposit is discussed below.

2.2.1 Regional Geology

The Project area lies near the southwestern extremity of the Late Devonian to Early Permian Maritimes Basin and is assigned to the Moncton Sub-basin of southern New Brunswick. This sub-basin is defined by partly structurally controlled depositional centres filled with a variety of mostly terrestrial clastic sedimentary rock units that were mainly derived from surrounding basement uplifts (Horton and Sussex groups). 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, initiation of

new centres and renewed basement uplifts. 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 (Windsor Group) that rest with marked unconformably on all older units and that host the Upham East gypsum deposit. Renewed deposition of mainly terrestrial clastic sedimentary rock sequences (Mabou, Cumberland, and Pictou groups) ensued for the rest of Carboniferous and Early Permian time with major units separated by basin-wide disconformable to unconformable contacts (e.g., St. Peter and Johnson 2009).

The Upham East property occurs along the southern margin of the Moncton Sub-basin, which in this area is a northeast-trending half-graben formed along the northern margin of Late Neoproterozoic to Cambrian basement rocks assigned to the Caledonia Uplift. This half-graben is defined by a shallowly northwest-dipping unconformity at the base of the Windsor Group rocks to the southeast, as exemplified at Upham East, and a near vertical major fault along its northwestern flank. Overall, the graben constitutes a Windsor Group-filled basin several kilometres wide and tens of kilometres long, gradually deepening to over a kilometre to the northwest.

2.2.2 Property Geology – Bedrock

The Windsor Group at Upham East comprises thin basal units a few tens of metres thick comprising red pebble conglomerate of the Hillsborough Formation overlain by laminated carbonates of the Macumber Formation. These basal units unconformably rest upon Cambrian-aged clastic sedimentary basement rocks of the Caledonia Uplift along the southern part of the property. The carbonates are, in turn, overlain by Upperton Formation sulphates that appear to range in thickness from a few metres near the Windsor-basement unconformity to several tens of metres at the northern part of the property. However, basal units have not been intersected in drilling in the central and northern part to date. To the north of the property, red and minor grey sandstones and some coarser clastic rocks of the Mabou Group overlie the sulphates with a shallow, more northerly dipping unconformable contact (McCutcheon 1981; Barr and White 2005).

Work to date on the property indicates gypsum formed by waters hydrating primary anhydrite of the Upperton Formation and infiltrating as fronts through a combination of top down water movement and/or migration along internal dissolution zones, some of which may have been generated by faulting (see models by Boehner [2003]). The former mechanism is clearly evidenced in the field by the present karst topography-gypsum distribution relationships, and the later in drill core by the presence of leached zones at depth and by drill intersections where post Upperton-age material partly to totally fills cavities in and near gypsum zones.

2.2.3 Property Geology – Surficial

Surficial materials in the planned development area consists of a thin veneer of rubble under which highly variable thicknesses of red and greyish brown to black mud and clay with or without variable amounts of randomly distributed angular fragments and debris. Where present, the fragments range in size from pebbles to cobbles and are typically calcareous red to grey sandstones. The finer debris usually

consists of calcareous red mudstone and siltstone fragments and chips, and rare pieces of carbonate or volcanic rocks.

The wide range in thicknesses for the overburden is a function of the obvious karst topography that signifies underlying sulphates of the Windsor Group on the property. Unfilled sinkholes reveal gypsum outcrops among stacks of gypsum on the northwestern part of the property, while they are mostly filled on the remainder of the property. Overburden thickness normally range from about 6 m to 20 m in drill holes that intersected gypsum, and one hole over the sulphate unit bottomed in overburden at about 26 m. The holes drilled south of the sulphate unit typically have deeper overburden up to 35 m thick. Thicknesses over the basement unit further south will likely be less and more consistent, as indicated by the one drilled into that unit that cut only about 6 m of overburden and because it is devoid of karsting.

2.2.4 Mineralization

Good quality gypsum intervals in drill core either completely replacing anhydrite sections or interspersed with anhydrite occur in seven holes on the property. Intersections range from a few metres to about 16 m in width on the southern, central and western parts of the property, while one hole near the northern property boundary intersected a total of about 67 m of gypsum in two sections separated by about 19 m of anhydrite. This hole and one other in the central part of the property bottomed in high-grade gypsum. Two surface samples from the northwest corner of the property also returned good grade gypsum. The other six holes drilled to date intersected either basal carbonate units or basement or were stopped in thick overburden.

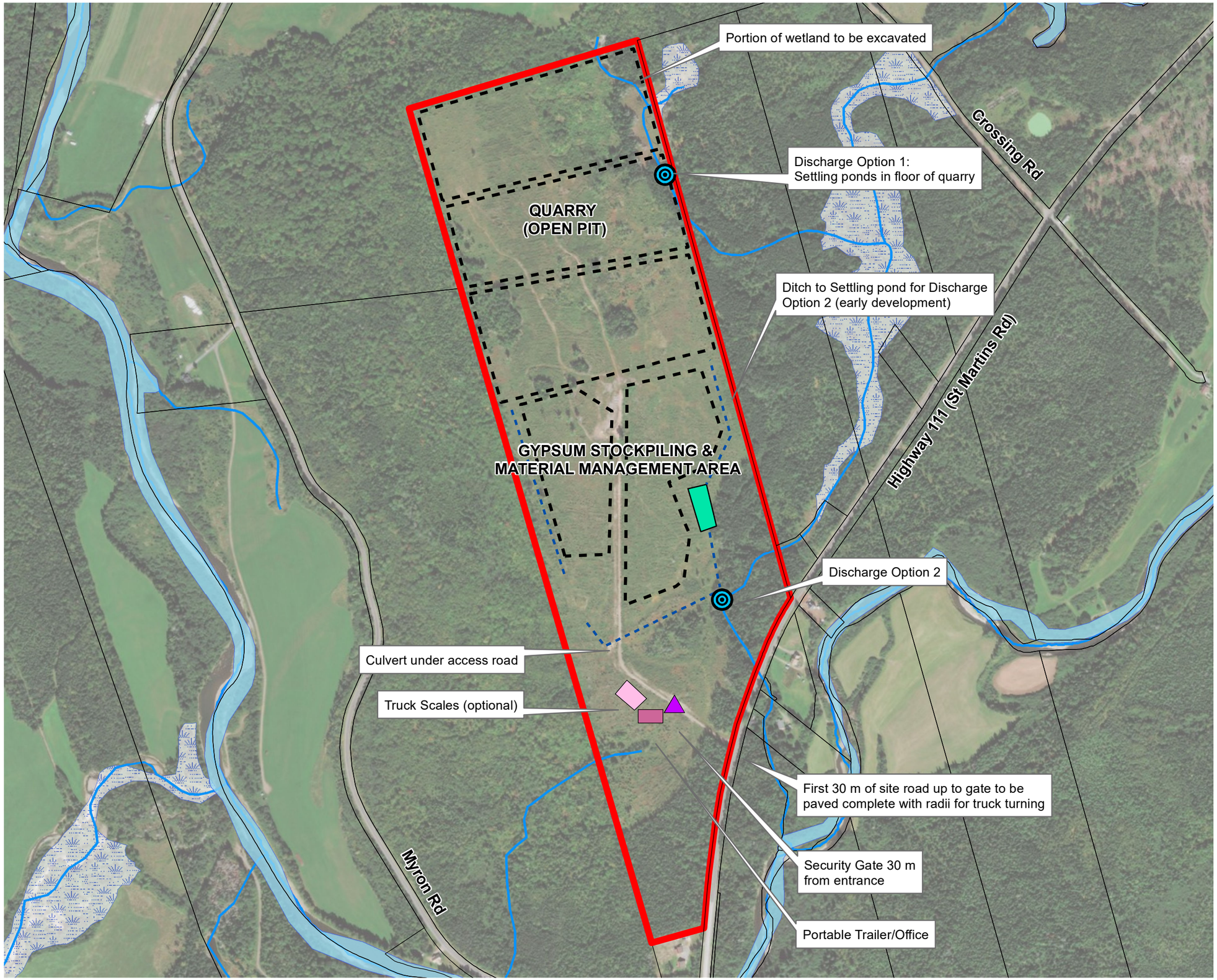
2.3 Description of Project Components

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 Upham East site is located largely to the north and centre of the property as shown in **Figure 2.3.1**, with the northernmost portion of the site hosting the thickest portion of the gypsum deposit (approximately 60 m thick, underneath approximately 15 m of overburden), and with the thickness of the mineral deposit progressively decreasing as one moves towards the central portion of the site, which hosts gypsum mineral to a thickness of approximately 20 m covered by approximately 10 m of overburden.



HAMMOND RIVER HOLDINGS LIMITED
PROPOSED UPHAM EAST GYPSUM QUARRY

CONCEPTUAL SITE LAYOUT PLAN
FIGURE 2.3.1

- PROPERTY BOUNDARY
- PROJECT DEVELOPMENT AREA
- WATERBODY
- WATERCOURSE
- REGULATED

PROPOSED SITE FEATURES

- DITCH
- TRUCK SCALE (OPTIONAL)
- SITE AREAS
- SETTLING POND
- DISCHARGE POINT
- SECURITY GATE
- PORTABLE TRAILER/OFFICE

0 50 100 200 m

SCALE 1:7,000

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: BQS
MAP REVISED BY: JH
MAP CHECKED BY: DM
MAP PROJECTION: NAD_1983_CSRS_New_Brunswick_Stereographic

FILE LOCATION: \\DILLON.CA\DILLON_DFS\FREDERICTON\FREDERICTON CAD\CAD\GIS\188346 UPHAM GYPSUM QUARRY\MXD

DILLON CONSULTING

PROJECT: 18-8346
STATUS: FINAL
DATE: OCT 2018

Based on the geology of the Project site and the nature of the deposit, quarrying will occur in zones, with topsoil and overburden being removed progressively over the life of the Project to access the underlying gypsum deposit in phases in the open pit/quarry area. As such, the area and depth of the open pit will become progressively greater over time as the pit expands to access other portions of the gypsum deposit. Efforts will be undertaken to maintain treed buffers along property lines to the extent possible, and the "Rock Quarry Siting Standards" published by NBDELG (NBDELG 2014) will be observed.

The open pit will be developed in each zone 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.

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. If an on-site explosives magazine is ultimately determined to be required, the licensed explosives contractor will obtain the appropriate authorization under the federal *Explosives Act* and appropriate setback distances as specified in the *Explosives Act* will be observed. The broken rock will be delivered to the on-site primary crusher. Alternatively, where physical characteristics of gypsum allow and it is deemed economically viable, blasting may be substituted with mechanical rock breaking.

The ultimate extent of the open pit at the end of quarry life will be approximately 23 ha. At its deepest point, the open pit will be approximately 75 m 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. The crusher will most often be located within the open pit, although at times it may be located at surface, outside the pit (e.g., during dewatering, or when new benches are being excavated). Locating the crusher within the open pit is highly desirable as it minimizes material handling, and because it is located at depth, it reduces the potential for dust and noise to cause off-site impacts at neighbouring residences.

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 onto articulated rock 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 10-20 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 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. Perimeter channels constructed around the perimeter of the site will prevent water from neighbouring properties from entering the site, so as to minimize the amount of water needing management on-site.

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 have anticipated surface area of up to 6 ha (depending on how much water can be stored in the open pit sump), and combined with the pit sump, will be designed to store 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 at least once per year (or more frequently 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 (Optional)

As an optional component, a truck scale may 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.

Alternatively, the loaders will be fitted with scales to measure the weight of the load being placed on the trucks. Additionally, trucks will be weighed upon arriving and when leaving wallboard facilities.

2.3.7 Portable Trailer/Office (Optional)

An optional portable trailer will serve as a site office and lunch room at the Project site.

2.3.7.1 Potable Water and Sanitary Sewer

During construction, sanitary needs will be met by using bottled water and a portable toilet (managed and periodically serviced by a third party company).

During operation, consideration will be given to installing a potable water well and septic tank and sub-surface disposal field for the duration of the Project. If they are required, the well will be approved under the *Potable Water Regulation* under the *Clean Water Act*, and the septic tank and disposal field will be approved under the *On-site Sewage Disposal System Regulation* under the *Public Health Act*. Water consumption would be expected to be modest (approximately 50 L/day per person on site, for approximately 6-10 people). Alternatively, sanitary needs could be met in a manner similar to during construction (i.e., bottled water and portable toilets).

2.3.7.2 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 30-50 m in length) to connect the portable trailer to the existing electrical grid located along Route 111. 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.

2.3.8 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 111.

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.).

2.3.9 Site Access and Internal Site Roads

As shown on **Figure 2.3.2**, access to the Project site will be provided via the south of the site using an existing access road off Route 111 that will be upgraded to suit the Project purposes. The existing access road for the Project site was developed for the purpose of logging the subject property in the early 2010s.

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.

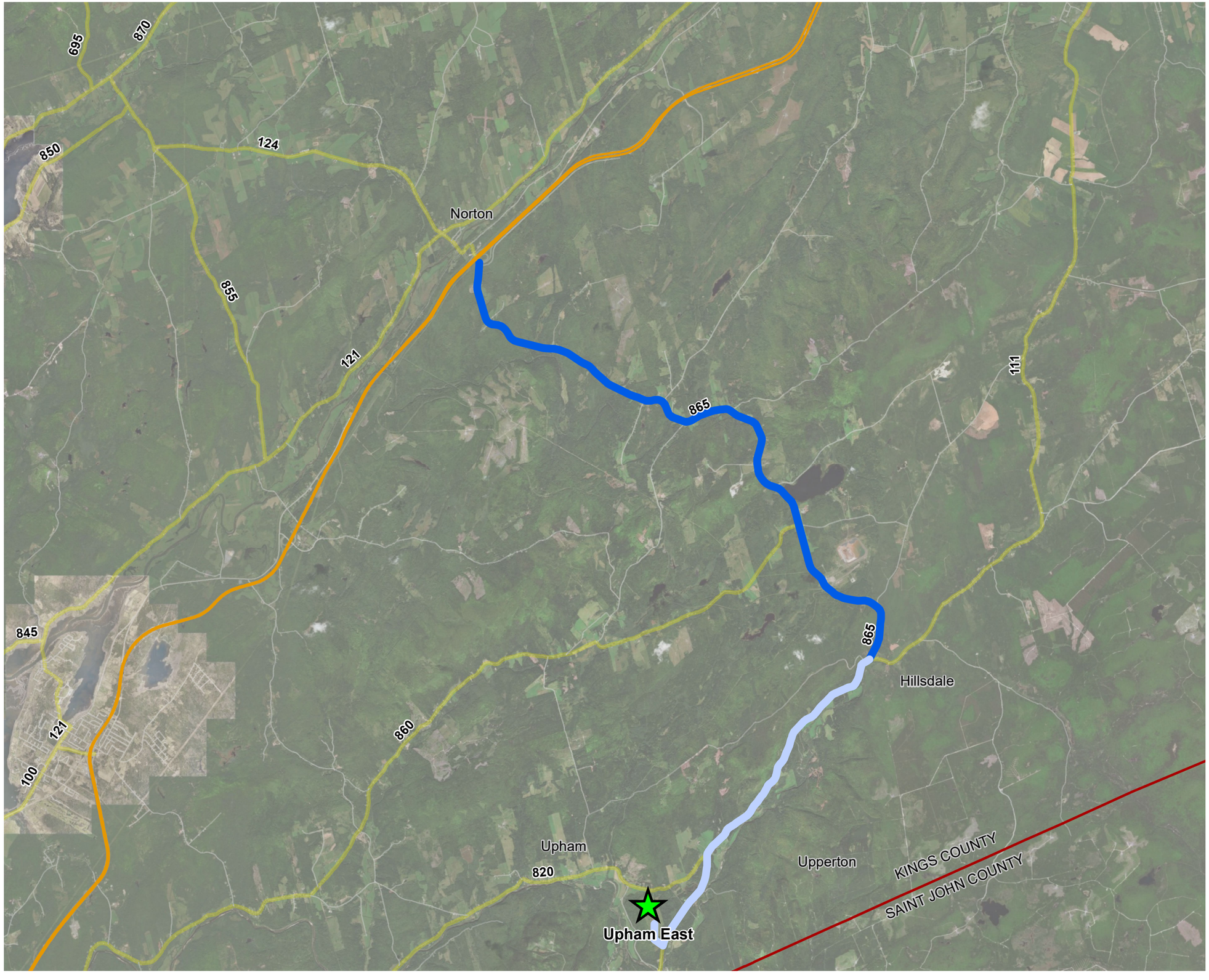
The initial 30 m of access road to the site (i.e., between Route 111 and the security gate) will be paved to minimize the transport of dust and mud from internal site roads onto the provincial highway network. The access road will be appropriately flared in both directions at an appropriate radius to facilitate the turning movements of heavy trucks entering and leaving the Project site.

2.3.10 Preferred Transportation Route

The preferred transportation route from the site to connect to Saint John is shown in **Figure 2.3.2**. From the site access road, trucks will enter the provincial highway network via Route 111 in a northeasterly direction until it intersects with Route 865 at Hillsdale, then onto Route 865 in a northwesterly direction until it intersects with Route 1 at Norton, then onto Route 1 where trucks will then follow the provincial highway system to deliver product to customers. Route 111/Route 865/ Route 1 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, although a 9 km section of Route 111 (as shown in the light blue colour on **Figure 2.3.2**) will require a condition assessment by the New Brunswick Department of Transportation and Infrastructure (NBDTI) to confirm the weight bearing capacity of the route and determine its suitability to meet the Project needs.

2.3.11 Hazardous Materials Use and Storage

As the Project involves little material handling and no chemical processing, there are no chemicals required for the Project operation, nor any chemical storage required on the Project site.



HAMMOND RIVER HOLDINGS LIMITED
PROPOSED UPHAM EAST GYPSUM QUARRY

PREFERRED TRANSPORTATION ROUTE
FIGURE 2.3.2

- PROJECT LOCATION (TRANSPORTATION ROUTE END POINT)
- SECTION OF PREFERRED TRANSPORTATION ROUTE RATED AT 62,500 KG GVM
- SECTION OF PREFERRED TRANSPORTATION ROUTE RATED AT 43,500 KG GVM
- HIGHWAY 1 GATEWAY TO MAJOR CENTERS
- NB ROAD NETWORK - HIGHWAY/EXPRESSWAY
- NB ROAD NETWORK - LOCAL STREETS
- COUNTIES



0 1.25 2.5 SCALE 1:95,897 5 km

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: BQS
MAP REVIEWED BY: JH
MAP CHECKED BY: DM
MAP PROJECTION: NAD_1983_CSRS_New_Brunswick_Stereographic

FILE LOCATION: \\DILLON.CA\DILLON_DFS\FREDERICTON\FREDERICTON CAD\CAD\GIS\188346 UPHAM GYPSUM QUARRY\MXD

DILLON CONSULTING

PROJECT: 18-8346
STATUS: FINAL
DATE: OCT 2018

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.* 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.

2.3.12 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 transport trucks.

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 the early 2010s 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 and watercourse/wetland 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 supplemented by manual methods (e.g., chain saws, brush saws) supplemented, as necessary, by forest harvesting machinery if required. 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). Clearing near watercourses and wetlands, if necessary, will be conducted manually.

Clearing activities will be conducted outside of normal bird breeding season (early April to end of August) 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, any 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 phase 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 a skidder 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

Once the southern portions of the Project site are cleared and grubbed, location of the surface facilities to be located on the southern half of the site (as shown in **Figure 2.3.1**) 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 Area

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 10 to 15 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 bedrock is 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 all 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 to 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 treated as well as to prevent the release of potentially sediment-laden water from entering watercourses and wetlands untreated. Perimeter and drainage channels will be excavated using an excavator or backhoe, and lined with riprap or vegetated to limit erosion within the channels.

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 gypsum. The ability for some amount of stored water to naturally infiltrate the bottom of the pond is a beneficial feature that minimizes the volume of water to be released to receiving watercourses and minimizes effects on groundwater levels.

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 to ensure that sufficient storage capacity is available to allow for a minimum 24-hour residence time for stored water under normal operating conditions. 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, the first 30 m of the site access road will be paved to prevent the undue release of dust from unpaved roads near the highway system. The end of the access road will be flared to a suitable radius to facilitate truck turning movements.

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

Once all other surface facilities have been developed, the optional truck scale (if required) will be installed. An optional 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 shovel 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 rock will be excavated from the active pit area and delivered to the portable crusher.
- 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 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 250,000 t/yr of gypsum will be transported to customers. Assuming the use of trucks carrying approximately 22 tonnes of material at a time, and assuming 300 days of year of potential trucking, approximately 35-40 trucks per day on average would be required to carry the annual production of natural gypsum to markets. In the event that the entire preferred trucking route is able to sustain loads of up to 62,500 kg GVM, larger trucks (e.g., “B-train” tandem trucks) could be used to reduce the number and frequency of shipments, should highway conditions permit.

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 200 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 stored in a sump at the bottom of the open pit, below the working bench, and periodically pumped 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, if feasible.

All other surface water from runoff on the site will be directed via constructed drainage channels to the settling pond. Water will be stored in the settling pond for an approximate minimum residence time of 24 hours 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 its 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:

- 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 native species as appropriate; and,
- allowing the open pit to fill with water from natural precipitation (over time).

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*, which requires a reclamation and closure plan to be developed as a pre-requisite to obtaining a mining lease.

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

As a first step in decommissioning the site, any remaining gypsum material located in the storage area will be removed and transported to customers, or returned to the open pit. The surface facilities and infrastructure will then be decommissioned and removed, including the removal of all pumps, hoses, portable crusher, optional portable office/trailer, optional truck scale, mobile equipment, and any other machinery. All 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 area 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 maintained. Any drainage channels within the site itself will be directed if possible 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:** Construction will proceed for a period of up to 6 months, commencing as soon as the EIA review has been completed and the applicable permits, approvals or other forms of authorization have been obtained. For the purpose of this EIA Registration, it has been assumed that construction will begin in the second quarter of 2019. Clearing of trees and vegetation from the site would be conducted outside of the normal breeding bird season (early April to end of August).
- **Operation:** Operation will commence immediately following the construction phase and will continue for approximately 10 years or until the mineral resource is depleted. For the purpose of this EIA Registration, it has been assumed that the operation phase will begin in the fourth quarter of 2019.
- **Reclamation and closure:** Decommissioning of Project facilities and reclamation and closure of the Project site will occur following the completion of the operation phase. Closure will commence during the initial reclamation period and will be complete when the open pit is full of water.

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, 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 modest 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 isolated from nearby residences and within a significant tree buffer (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 isolated from, and relatively distant from nearby residences, and the presence of a significant 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, 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 all 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 Project site is isolated from, and relatively distant from, nearby residences, and the existing presence of a significant 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 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. Periodic pre-blast surveys will be conducted at the nearest residences, and blasts will be periodically monitored using seismographs, to ensure 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 any 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*.

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 site to the settling pond for settling prior to natural discharge. Perimeter ditches around the Project site will prevent off-site water from entering the site, thereby reducing the amount of water that would otherwise need to be managed.

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 discharge.

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, all 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 Fundy Region Solid Waste Commission landfill.

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 Hammond 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 only 10-15 m of overburden, 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.

Though other methods could be used, the development of the quarry through excavation in benches is the most common method of excavating rock quarries. The environmental effects of quarrying in benches or by other methods would not likely be distinguishable from each other.

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 these surface facilities elsewhere (or not at all), 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 very straightforward. Gypsum, by its very 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 sole objective of the water management facilities for the Project is to treat for the 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 all materials and surface facilities on the site, re-contouring and reshaping the site, re-vegetating the site as much as possible with native species as appropriate, 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 waste 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, with Route 820 located to the north of the Project site and Route 111 located to the south and east of the site. Myron Road, located to the west of the site, connects Route 820 and Route 111. An existing access road for the Project site was developed for the purpose of logging the subject property in the early 2010s, which accesses the Project site from the south of the property via Route 111.

The preferred transportation route was shown in **Figure 2.3.2**. From the site access road, trucks will enter the provincial highway network via Route 111 in a northeasterly direction until it intersects with Route 865 at Hillsdale, then onto Route 865 in a northwesterly direction until it intersects with Route 1 at Norton, then onto Route 1 to access the remainder of the provincial highway network for delivery of material to customers. In general, residences located along Route 111/Route 865 tend to be located at a greater distance from the road compared to other routes, thereby minimizing the effects of trucking operations along this route. Route 111/Route 865/Route 1 is preferred since it enables the transportation of larger payloads for most of its length (i.e., 62,500 kg GVM) compared to other trucking routes, although a 9 km section of Route 111 will need to be evaluated by the NBDTI to confirm the

weight bearing capacity of the route and to determine its suitability for the Project needs. Further information on these other routes is as follows.

- Route 111 is a paved road, designated as a provincial collector highway, connecting the Village of Sussex Corner in a north-south direction to the Village of St. Martin's (it also has an east-west component connecting St. Martin's to Rothesay). Route 111 has a weight bearing capacity of 43,500 kg GVM, thus using this road will require a 9 km length between the Project site and Route 865 to be upgraded to 62,500 kg GVM.
- Route 865 is a paved road, designated as a local highway, connecting the community of Hillsdale and the Village of Norton. It is rated for a gross vehicle mass of 62,500 kg GVM along its entire length.
- Route 1 is a paved four-lane provincial arterial highway that is a major thoroughfare from St. Stephen to River Glade. Route 1 is designated for highway speeds up to 110 km/h and has a weight bearing capacity of 62,500 kg GWM along its entire length.

An alternative transportation route could include accessing the highway network via Route 820, in a westerly direction to Route 111 at Loch Lomond, and finally either continuing on Loch Lomond Road to east Saint John or towards Route 1 at Rothesay and then onto Route 1. Route 820 is a secondary paved road, designated as a local highway, connecting the Loch Lomond area of Saint John and running in an east-west direction, terminating at Route 111 at the community of Upperton, east of Upham. Route 820 has a weight bearing capacity of 43,500 kg GVM. Approximately 23 km of Route 820 would need to be upgraded to 62,500 kg GVM for use by the Project. Given the longer length of road to be upgraded and the lower speed limits along its entire length, though technically feasible, it would not be an economically feasible alternative.

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 industry design and management standards to satisfactorily deal with environmental risks such as seismicity, 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 comply with 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 Aboriginal engagement, and public/stakeholder consultation, 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 Summary of Environmental Setting

The Project is located in southern New Brunswick approximately 16 km east of the Town of Hampton, New Brunswick, within the Hammond 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 near the southwestern extremity of the Late Devonian to Early Permian Maritimes Basin and is assigned to the Moncton Sub-basin of southern New Brunswick. This sub-basin is defined by partly structurally controlled depositional centres filled with a variety of mostly terrestrial clastic sedimentary rock units that were mainly derived from surrounding basement uplifts (Horton and Sussex groups).

The Upham East property occurs along the southern margin of the Moncton Sub-basin, which in this area is a northeast-trending half-graben formed along the northern margin of Late Neoproterozoic to Cambrian basement rocks assigned to the Caledonia Uplift.

3.1.2 Topography and Drainage

The topography of the Project site rises to over 105 m above mean sea level (m amsl) in the central portion of the Project site, and slopes downward to the east, south, and west towards the Hammond River (approximately 70 m amsl), and slopes upward in the north towards Route 820 (approximate maximum elevation of 99 m amsl). Drainage from the site is anticipated to flow to the east, south, and west, and ultimately into the Hammond River.

3.1.3 Surficial Geology

The surficial geology of the LAA consists of Late Wisconsonian glaciofluvial sediments deposited consisting of hummocky, ribbed, and rolling ablation till, some lodgement till, clay, minor silt, sand, gravel, and boulders, generally consisting of 1.5 m in thickness (Rampton 1984). Surficial materials in the Project area consists of a thin veneer of rubble under which highly variable thicknesses of red and greyish brown to black mud and clay with or without variable amounts of randomly distributed angular fragments and debris. Where present, the fragments range in size from pebbles to cobbles and are typically calcareous red to grey sandstones. The finer debris usually consists of calcareous red mudstone and siltstone fragments and chips, and rare pieces of carbonate or volcanic rocks.

3.1.4 Bedrock Geology

The bedrock geology of the area is made up of the Gays River Formation and the Macumber Formation. These formations are early Carboniferous aged, sedimentary deposits that form part of the Windsor

Group. The Gays River Formation is grey to brown or black fossiliferous and algal limestones. The Macumber Formation is grey to black sparsely fossiliferous, interclastic and/or pelletoidal limestone with minor intraformational breccia (Barr and White 2004).

From a recharge to groundwater perspective, the PDA is situated at a topographic divide whereby precipitation in this area is draining to the east and west into the Hammond 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.

Monthly mean wind speeds measured at the Saint John weather station (the nearest weather station to the Project) range from 11.3 to 17.5 km/h, with an annual mean wind speed of 15.2 km/h. From May to August, the dominant wind direction is from the south, with winds predominantly blowing from the southwest and northwest from September to February (GOC 2018). Maximum hourly wind speeds, averaged from 1981 to 2010 for each month, range from 61 km/h to 111 km/h, while maximum wind gusts for the same period range from 96 km/h to 148 km/h. The region receives an average of 1,295.5 mm of precipitation per year, with 1,076.0 mm as rain and 239.6 mm as snowfall (as water equivalent) (GOC 2018).

3.2.2 Atmospheric Environment

The Saint John and southern New Brunswick areas may experience some short-term challenges with ambient air quality due to their location downwind of large urban centres in eastern North America (as a result of long-range transport of air contaminants), their proximity to the Bay of Fundy (a large body of cool water that may produce weather conditions that inhibit dispersion), and the presence of several large emission sources in the area (particularly from heavy industry). Despite this, air quality in the region has improved considerably in the past decades and continues to improve. Based on the data from NAPS (2018), in general, air quality in Saint John (i.e., an urban area subject to occasional air quality challenges) 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 Upham area) can be inferred to be equivalent to, or better than, that in Saint John.

The Project is located in a rural, mostly forested area with limited residential dwellings nearby. 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

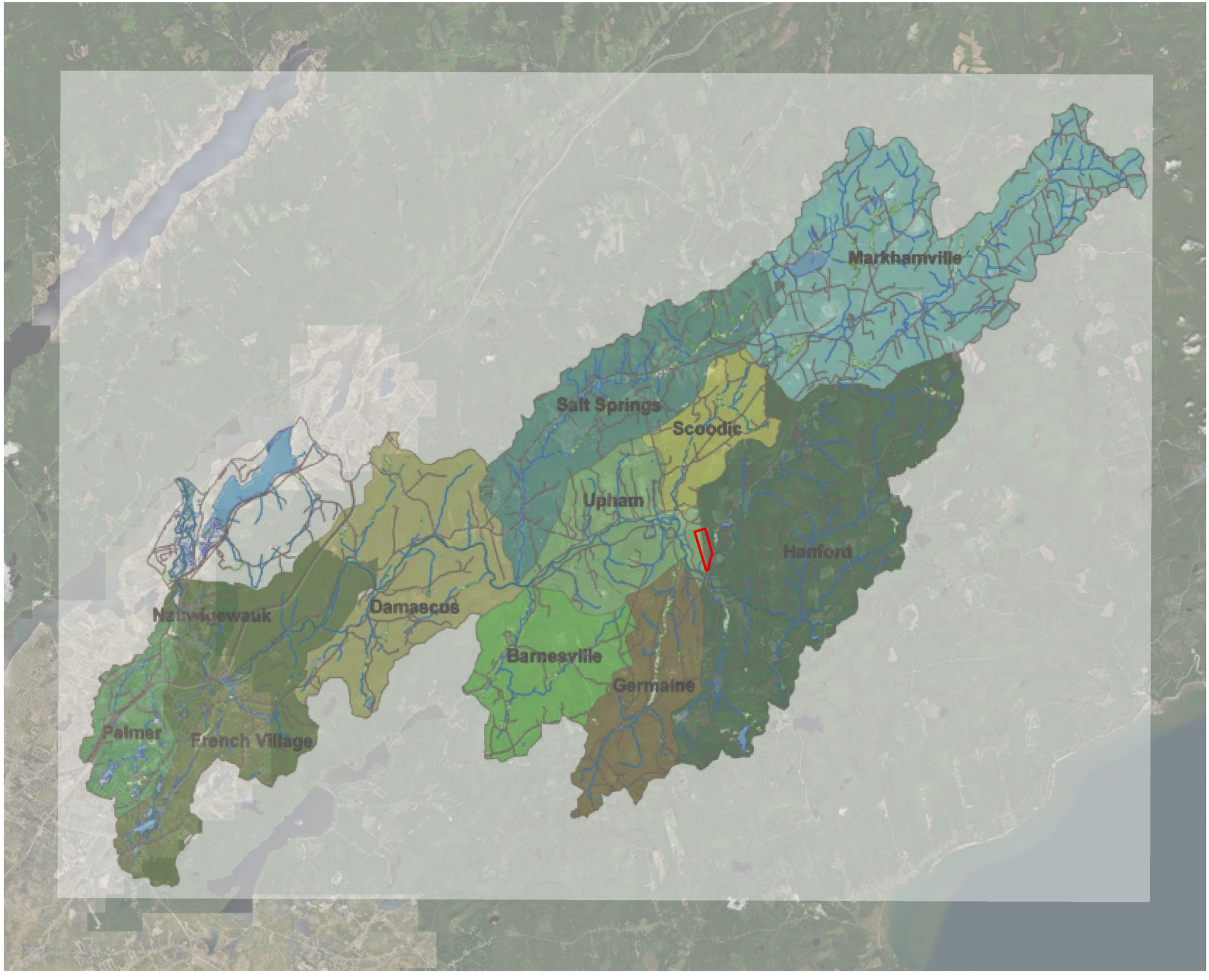
The Project is located in southern New Brunswick, approximately 16 km east of the Town of Hampton and lies within the Hammond River watershed. The Hammond River ultimately discharges into the Kennebecasis River which is part of the lower Saint John River. The Hammond River, shown in **Figure 3.2.1**, has a total drainage area of approximately 513 km^2 (NBDOE 2007). The Hammond River originates in the Caledonia Highlands near the rural community of Hammondvale and runs in a westerly direction for a distance of approximately 40 km into the Kennebecasis River at Nauwigewauk/Darlings Island. The Hammond River flows from the eastern side of the LAA, around the south and flows away from the LAA towards the Kennebecasis River to the west. The mapped watercourses (as mapped on the GeoNB website) that intersect with the PDA include the reaches of three small unnamed tributaries to the Hammond River, which are generally associated with wetland features on the Project site.

Fish species that typically reside in the Hammond River include Atlantic salmon (*Salmo salar*), brook trout (*Salvelinus fontinalis*), smallmouth bass (*Micropterus dolomieu*), rainbow smelt (*Osmerus mordax*), striped bass (*Morone saxatilis*), and shortnose sturgeon (*Acipenser brevirostrum*) (NBDOE 2007).

3.2.4 Terrestrial Environment

The Project is located within the Valley Lowlands ecoregion and, more specifically, within the Anagance ecodistrict, which hosts rugged terrain consisting of steep river valleys that bisect rugged hills and mountains (Zelazny 2007). This ecoregion is characterized by dramatic influence of major watercourses and large lakes (such as the Saint John River and its tributaries). The interaction of flood events through these major watercourses with the varied topography of the ecoregion creates a wide spectrum of flood and substrate conditions, with a corresponding diversity of wetland types (Zelazny 2007).

Within this ecoregion, tolerant hardwood stands dominated by American beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*) and yellow birch (*Betula alleghaniensis*) sit on ridge tops with fertile soils. On less fertile ridges, hardwoods tend to be dominated by American beech, red maple (*Acer rubrum*), and trembling aspen (*Populus tremuloides*). Softwood forests in the area tend to be associated with lower slopes and shallow soils. The softwood forests are dominated by red spruce (*Picea rubens*), balsam fir (*Abies balsamea*), and white spruce (*Picea glauca*), with occasional Eastern hemlock (*Tsuga canadensis*) and white pine (*Pinus strobus*) (Zelazny 2007).



HAMMOND RIVER HOLDINGS LIMITED
PROPOSED UPHAM EAST GYPSUM QUARRY

HAMMOND RIVER WATERSHED AND SUBCATCHMENTS
FIGURE 3.2.1

SITE LOCATION



0 1.25 2.5 5 km

SCALE 1:150,000

MAP DRAWING INFORMATION:
DATA PROVIDED BY DILLON CONSULTING LIMITED, CANVEC, HAMMOND RIVER ANGLING ASSOCIATION
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: BQS
MAP REVISED BY: JH
MAP CHECKED BY: DM
MAP PROJECTION: NAD_1983_CSRS_New_Brunswick_Stereographic

FILE LOCATION: \\DILLON.CA\DILLON_DFS\FREDERICTON\FREDERICTON CAD\CAD\GIS\188346 UPHAM GYPSUM QUARRY\MXD

DILLON CONSULTING

PROJECT: 18-8346
STATUS: FINAL
DATE: OCT 2018

3.3 Socioeconomic Setting

3.3.1 Demographic Overview

According to the Statistics Canada 2016 Census Profile for Upham Parish Census Subdivision (the smallest census division available for the Project location), the total population in 2016 was 1,269, down 2.8% from 1,306 in 2011. The population density of the parish is 6.7 persons per square kilometre, compared to 10.5 for the province. The age distribution of people living in Upham Parish for the 2016 Census indicates that the largest proportion of the population is in the 25-54 age group, followed by the 0-24 age group. The number of dwellings occupied by usual residents in Upham Parish is 521, while the total number of private dwellings is 579 (Statistics Canada 2017).

3.3.2 Economic Activity

The Project is located in the Southwest Economic Region which includes Saint John, Kings, and Charlotte Counties. The City of Saint John is the economic centre of the region and holds the largest population in the Southwest Region. The Upham area itself is a sparsely populated rural area of southern New Brunswick, with agriculture and forestry as the primary economic activities of the local area.

Few people living in Upham Parish work in the parish. The majority (94%) of residents who commute to their place of employment travel outside of the parish to work, and approximately 55% commute outside of Kings County to work.

Statistics Canada employment figures for the 2016 Census indicate that the construction industry is the largest employment sector for Upham Parish at 21%, followed by health care and social assistance care and retail trade sectors at 11% and 10%, respectively (Statistics Canada 2017).

3.3.3 Land Use

The Project is located in the small community of Upham, Upham Parish, Kings County, in Southern New Brunswick. Like other communities in the area, Upham 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) 8, which is comprised of 14 local service districts (LSDs), the Villages of Norton and Sussex Corner, and the Towns of Sussex and Hampton. The Project site is located within the LSD of Upham. Development in Upham Parish is not guided by a Rural Plan or Basic Planning Statement; however, development projects are subject to provincial regulations and permitting and inspections is managed by RSC 8.

Residential land use in the vicinity of the PDA is a linear pattern along the main roads, primarily Route 820 and Route 111. Approximately 20 residential dwellings are located within a 1 km radius of the Project site.

3.3.4 Infrastructure and Services

The Upham area is a sparsely populated rural area of southern New Brunswick, and few infrastructure and services are located nearby. The Upham Volunteer Firefighter Hall is located at 2268 Route 820 in Upham, approximately 4 km from the Project site. Other institutional land uses within the general vicinity are limited to local churches and community halls.

Policing services in the area are provided by the Royal Canadian Mounted Police (RCMP), with the nearest detachments located in Hampton 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, with the nearest hospitals located in Saint John.

Route 111 is the primary transportation route through Upham Parish. Route 111 runs between Sussex and St. Martins and connects with Loch Lomond Road in the City of Saint John. Secondary routes include Route 820 which connects Loch Lomond and Upperton east of the PDA, and Route 865 connecting Norton to Hillsdale.

There are no active rail lines or airfields in Upham Parish. The nearest operational rail line is a Canadian National (CN) Rail line, which runs between Moncton and Saint John. The Saint John Airport is located in Loch Lomond, approximately 25 km west of Upham.

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 environmental assessment under the *Canadian Environmental Assessment Act, 2012,* since the Project is not located on federal land and gypsum extraction is not a designated project as defined in the *Regulations Designating Physical Activities* under that Act.

The Project includes the development of an open pit, onsite 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 any 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) 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 Aboriginal 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 Aboriginal 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).
Socioeconomic environment	• The Project will interact with labour and economy through the generation of employment and associated expenditures. • The Project may result in a change in land use from forestry to industrial 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 any 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 Wolastoqey 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, Aboriginal persons for practicing traditional activities such as hunting, fishing, trapping and gathering through the practice of unextinguished Aboriginal and treaty rights. Consultation with Aboriginal peoples is required at the planning stage of the project to determine the extent of potential traditional land and resource use of the site.

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

Valued Component (VC)	Rationale for Selection of the VC
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 this environmental effects assessment, 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, as well as through discussions with the Proponent, NBDELG, and other stakeholder agencies.

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, the 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**, as follows:

- **Construction:** Construction will proceed for a period of up to 6 months, commencing as soon as the EIA review has been completed and the applicable permits, approvals or other forms of authorization have been obtained. For the purpose of this EIA Registration, it has been assumed that construction will begin in the second quarter of 2019. Clearing of trees and vegetation from the site would be conducted outside of the normal breeding bird season (early April to end of August).

- **Operation:** Operation will commence immediately following the construction phase and will continue for approximately 10 years or until the mineral resource is depleted. For the purpose of this EIA Registration, it has been assumed that the operation phase will begin in the fourth quarter of 2019.
- **Reclamation and closure:** Decommissioning of Project facilities and reclamation and closure of the Project site will occur following the completion of the operation phase. Closure will commence during the initial reclamation period and will be complete when the open pit is full of water.

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 VEC (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 any 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; and,
- comments from the public, Aboriginal persons, 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 consultation. 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 • Fisheries including sport or subsistence fisheries • Fish migration routes/movement corridors • Surface water quality	• Review of historical occurrences of species at risk/species of conservation concern • 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
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, incidental wildlife observations

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
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 consultation • 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) • Quantitative archaeological assessment based on desktop review • Provision for later field investigation (walkover and/or 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 Aboriginal persons	• Aboriginal consultation • Information from secondary sources
Effects of the environment on the Project	Changes or potential effects on the Project caused by: • Extreme weather • Climate change • Seismic activity • 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 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). All phases of the Project are 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.

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	✓	✓	✓
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 any 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 wetlands (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 wetlands and 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 wetlands, which 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 adjacent wetlands. Upon reclamation and closure, vegetation will be able to naturally regenerate over time, and wetlands that were not lost through the development of the open pit may be naturally restored. Additionally, wetland creation/enhancement around the open pit may occur as a part of the wetland 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 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 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.

5.1.7 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.

5.1.8 Traditional Land and Resource Use

During the construction phase, any Aboriginal 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 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 2018). 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 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

Air Contaminant	Averaging Period	New Brunswick Air Quality Regulation	National Ambient Air Quality Objectives (NAAQO)	
		Maximum Permissible Ground Level Concentration	Maximum Acceptable Level	Maximum Desirable Level
		(µg/m3)	(µg/m^3)	(µg/m^3)
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	450*	900	450
	24 hour	150*	300	150
	Annual	30*	60	30
Hydrogen sulphide (H_2S)	1 hour	15	--	--
	24 hour	5	--	--

Source: New Brunswick Regulation 97-133; NAPS (2018)
Note: NAAQO uses conditions of 25 °C and 101.3 kPa in converting from µg/m^3 to ppm.
Note: * SO_2 standard applicable in Saint John, Charlotte, and Kings Counties

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 six months, anticipated to begin in the second quarter of 2019 (subject to the receipt of all approvals and permits required for the Project);
- Operation: beginning in approximately the fourth quarter of 2019, 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 61.81 ha (i.e., conservatively assumed to be the entirety of PID No. 00149013) 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 any 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 Schedules B and C 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 Saint John Airport) are presented in **Table 5.2.2** below.

Table 5.2.2: Climate Normals, Saint John (Saint John Airport), New Brunswick (1981-2010)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temperature Normals, Saint John (1981 - 2010)													
Daily Average (°C)	-7.9	-7.1	-2.5	3.7	9.5	14	17.1	16.8	13	7.6	2.3	-4.4	5.2
Daily Maximum (°C)	-2.5	-1.5	2.4	8.5	15	19.6	22.6	22.4	18.2	12.3	6.4	0.5	10.3
Daily Minimum (°C)	-13.3	-12.6	-7.4	-1.2	3.9	8.4	11.6	11.2	7.7	2.8	-1.9	-9.3	0
Precipitation Normals (1981 - 2010)													
Rainfall (mm)	66.1	49	66.6	85.7	108.5	101	88.4	81.7	105.6	115.8	123.7	84	1,076
Snowfall (cm)	64.3	48.4	44.4	20	1.2	0	0	0	0	0.5	10.8	49.9	239.6
Precipitation (mm)	123.5	91	108.2	105.3	109.8	101	88.4	81.7	105.6	116.4	134.1	130.4	1,295.5
Wind Normals (1981-2010)													
Speed (km/h)	16.9	17.1	17.5	17.2	15.4	13.4	12	11.3	13	15.1	16.4	17.1	15.2
Most Frequent Direction	NW	NW	N	N	S	S	S	S	SW	SW	NW	NW	SW
Maximum Hourly Speed (km/h)	111	100	80	85	64	61	76	68	97	89	89	83	Not applicable
Direction of Maximum Hourly Speed	SW	S	S	N	S	S	W	N	S	N	S	S	Not applicable

Source: Canadian Climate Normals (GOC 2018)

Greenhouse gas emissions in Canada totaled 704 million tonnes (Mt CO_2e, as CO_2-equivalents) in 2016 (ECCC 2018a), 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 15.3 Mt CO_2e in 2016, whereas they were 16.1 Mt CO_2e in 1990 and 20.1 Mt CO_2e in 2005. Since 2005, New Brunswick has seen a 24% decrease in total greenhouse gas emissions.

5.2.2.2 Ambient Air Quality

The air quality within the assessment can be defined from historical air quality monitoring conducted in the region for the key contaminants of concern. Data collected at New Brunswick's Forest Hills monitoring station is used as it is the closest representative station to the Project site. The monitoring data, collected as part of the National Air Pollution Surveillance (NAPS) Network, are presented in **Table 5.2.3**.

Table 5.2.3: Ambient Monitoring Data – Forest Hills, Saint John, New Brunswick, 2014-2016 Maximums

Air Contaminant	Averaging Period	2014 Maximum	2015 Maximum	2016 Maximum
Particulate matter less than 2.5 microns ($PM_{2.5}$) ($\mu g/m^3$)	24 hour	23	25	23
	Annual	6	7	8
Carbon monozide (CO) (ppm / mg/m^3) *	1 hour	0.8/0.9	0.9/1.0	0.9/1.0
	8 hour	0.5/0.6	0.7/0.8	0.5/0.6
	Annual	0.2/0.2	0.2/0.2	NR
Nitrogen dioxide (NO_2) (ppb / $\mu g/m^3$)	1 hour	41/77	46/87	31/58
	Annual	3/6	3/6	3/6
Sulphur dioxide (SO_2) (ppb / $\mu g/m^3$)	1 hour	100/262	149/391	72/189
	24 hour	27.6/72.3	22.1/58	26.7/70.0
	Annual	2/5	2/5	2/5

Notes: http://www.endmemo.com/sconvert/mg_m3ppm.php

* Results from nearest monitoring station with available data, located at 189 Prince William Street, Saint John, NB

NR = not reported

Source: NAPS (2018)

The Saint John and southern New Brunswick areas may experience some short-term challenges with ambient air quality due to their location downwind of large urban centres in eastern North America (as a result of long-range transport of air contaminants), their proximity to the Bay of Fundy (a large body of cool water that may produce weather conditions that inhibit dispersion), and the presence of several large emission sources in the area (particularly from heavy industry). Despite this, air quality in the region has improved considerably in the past decades and continues to improve. Based on the data from NAPS (2018), in general, air quality in Saint John (i.e., an urban area subject to occasional air quality challenges) 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 Upham area) can be inferred to be equivalent to, or better than, that in Saint John.

5.2.2.3 Sound Quality

In order to establish existing conditions for sound quality, baseline sound monitoring was conducted at the boundaries of the Project area near the closest potential sensitive receptors. The program consisted of 24-hours of continuous sound monitoring at two locations identified in **Figure 5.2.1**. The two locations selected include one monitor at the north end of the property located near the northeast corner of the quarry at a distance approximately equidistant from Route 820 as the residences on the north side of the road are to Route 820. Since baseline noise is currently generated from road traffic,

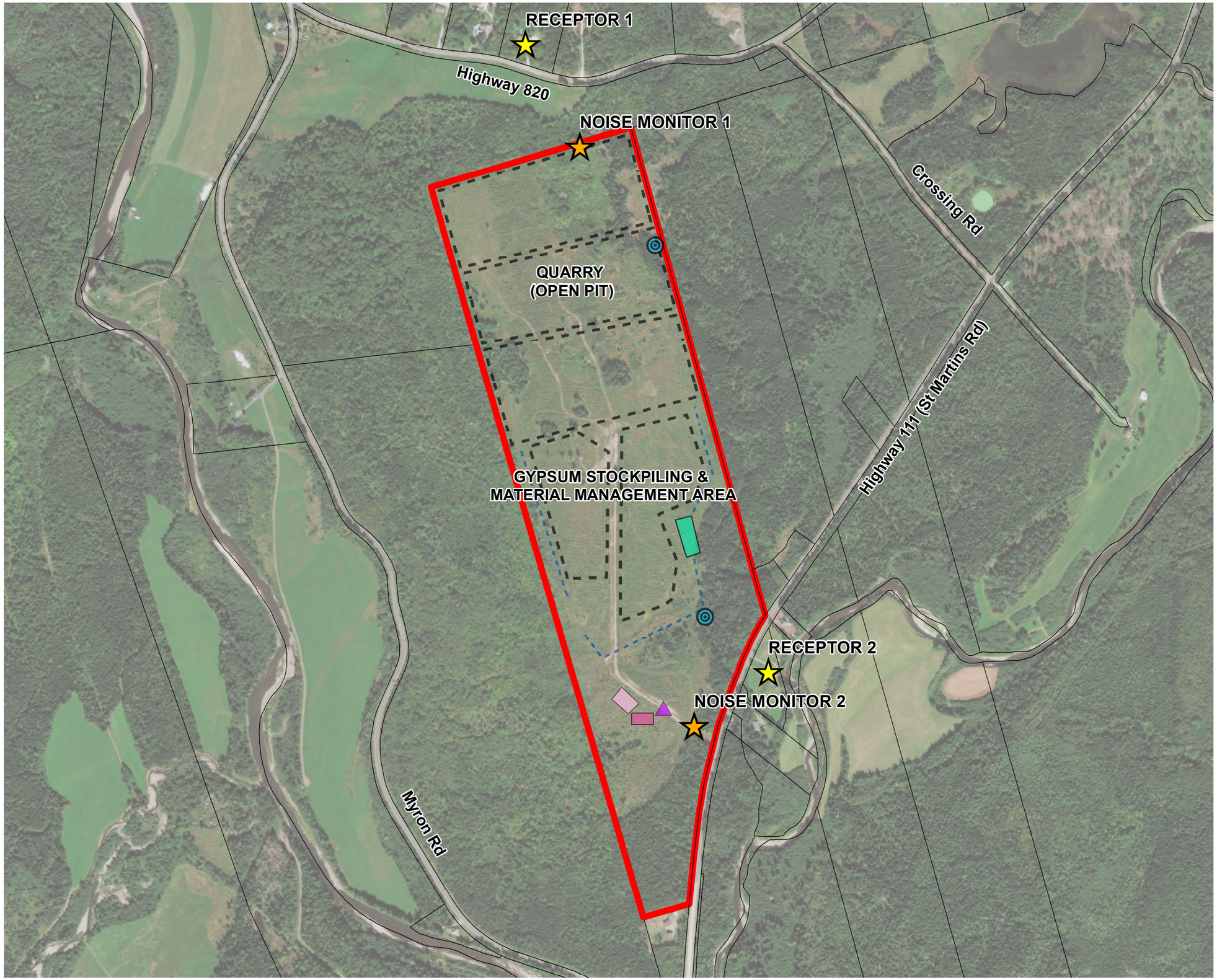
this location is considered representative of those residences on the north side of Route 820 (Receptor 1). The second monitor location is on the edge of the site access road off of Route 111 at a distance from Route 111 similar to the distance of the residences (Receptor 2) from Route 111.

The monitoring was conducted using two calibrated RION Type II sound level meters, each being equipped with wind-screen and data logger. The monitoring was completed between September 24 and 25, 2018. The A-weighted maximum, minimum, and mean hourly sound level equivalents (LeqA) for daytime (06:00 – 22:00) and nighttime (22:00 – 06:00) are presented in **Table 5.2.4**. Also included in **Table 5.2.4** are the 90th percentile sound levels (i.e., Lp90). Refer to **Figure 5.2.1**.

Table 5.2.4: Sound Monitoring Results – September 24-25, 2018

Monitoring Location ID	Monitoring Location Description	Maximum 1-Hour Leq (dBA)	Minimum 1-Hour Leq (dBA)	Geometric Mean 1-Hour Leq (dBA)	Average Lp90 (dBA)
Daytime (06:00-22:00)					
Monitor 1	Residential properties located adjacent to road (Route 820) near the northern boundary of the PDA.	44.5	26.9	37.4	24.3
Monitor 2	Residential properties adjacent to Route 111 south of the PDA.	45.5	33.7	39.5	24.5
Nighttime (22:00 to 06:00)					
Monitor 1	Residential properties located adjacent to road (Route 820) near the northern boundary of the PDA.	33.7	21.5	26.5	17.9
Monitor 2	Residential properties adjacent to Route 111 south of the PDA.	33.7	20.0	27.6	16.6

The baseline sound monitoring results were all well below the criteria at both locations for both daytime and night time. The 1-hour maximum Leq values at both locations were similar and in the order of 45 dBA during the daytime and 34 dBA during the nighttime.



HAMMOND RIVER HOLDINGS LIMITED
PROPOSED UPHAM EAST GYPSUM QUARRY

NOISE MONITORING LOCATIONS
FIGURE 5.2.1

- NOISE MONITOR LOCATION
- RECEPTOR LOCATION
- PROPERTY BOUNDARY
- PROJECT DEVELOPMENT AREA

PROPOSED SITE FEATURES

- DITCH
- TRUCK SCALE (OPTIONAL)
- SITE AREAS
- SETTLING POND
- DISCHARGE POINT
- SECURITY GATE
- PORTABLE TRAILER/OFFICE

0 50 100 200 m

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: BQS
MAP REVISED BY: JH
MAP CHECKED BY: AS
MAP PROJECTION: NAD_1983_CSRS_New_Brunswick_Stereographic

FILE LOCATION: \\DILLON.CA\DILLON_DFS\FREDERICTON\FREDERICTON CAD\CAD\GIS\188346 UPHAM GYPSUM QUARRY\MXD

DILLON CONSULTING

PROJECT: 18-8346
STATUS: FINAL
DATE: OCT 2018

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 several 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

With respect to air quality, 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, and material movement for stockpiling using a dozer. Estimates of emissions associated with the 6-month construction phase are summarized in **Table 5.2.5**.

Table 5.2.5: Total Emissions Associated with Construction (Over an Assumed 6 Month Period)

Air Contaminant	Excavating	On-Site Trucking	Stockpiling	TOTAL
PM (tonnes)	0.016	0.022	2.625	**2.66**
PM_{10} (tonnes)	0.016	0.022	0.503	**0.54**
$PM_{2.5}$ (tonnes)	0.016	0.022	0.282	**0.32**
CO (tonnes)	0.039	0.054	0.019	**0.11**
NO_X (tonnes)	0.187	0.259	0.091	**0.54**
SO_2 (tonnes)	0.111	0.153	0.054	**0.32**
CO_2 (tonnes)	174.029	240.909	84.106	**499.04**

Notes: Emission Factors from AP-42, Sections 11.9, 11.19, 13.2 and 13.3 (USEPA 2018)

It should be noted that the majority of emissions associated with the construction phase are related to fugitive dust due to the removal of the overburden. The removal of all of the overburden is accounted for in the construction phase emissions summary above, for simplicity. However, some of the overburden will be removed in stages during the operation of the Project. Emissions associated with combustion of diesel fuel is expected to be very localized and minimal.

Emissions related to operation activities are expected to be fairly localized. Emissions associated with fuel combustion from operations are not expected have a substantive effect on air quality. Fugitive emissions of particulate matter will largely be localized to the activity at the site and primarily during removal and handling of the overburden. The surface of the stockpiled topsoil and overburden piles will naturally harden over time, and will naturally re-vegetate over time; therefore fugitive emissions from wind erosion of the topsoil and overburden storage piles are not anticipated.

With respect to climate, total greenhouse gas emissions during construction are estimated to be 499 tonnes (as CO_2-equivalents), which represents less than 0.004% of New Brunswick's last reported total of 15.3 Mt CO_2e in 2016. Given the relatively low magnitude of emissions, no further action is taken in the analysis as per the guidance provided in the document titled *Incorporating Climate Change Considerations in Environmental Assessment: General Guidance for Practitioners* (CEA Agency 2003).

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 east (Receptor 2) of the Project site. 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 5.2.6**.

Table 5.2.6: 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	1,119	44.4	40.4	361	54.2	50.2
Excavator	80.7	381	52.8	48.8	1,183	42.9	38.9
Excavator	80.7	381	52.8	48.8	1,183	42.9	38.9
Front End Loader	79.1	1,119	41.8	37.8	361	51.6	47.6
Truck	76.5	1,119	39.1	35.2	361	49	45
Truck	76.5	381	48.5	44.5	1,183	38.7	34.7
Truck	76.5	381	48.5	44.5	1,183	38.7	34.7
Truck	76.5	381	48.5	44.5	1,183	38.7	34.7
Truck	76.5	381	48.5	44.5	1,183	38.7	34.7
TOTAL	--	--	**52.8**	**54.9**	--	**54.2**	**54.1**

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

Operation Phase

With respect to air quality, emissions during the operation phase are primarily related to fuel combustion from on-site equipment. Additionally, fugitive emissions of particulate matter are anticipated, primarily from blasting activities. These activities have the potential to result in changes in the local air quality.

Estimates of emissions associated with the operation phase of the Project are summarized in **Table 5.2.7**.

Table 5.2.7: Annual Emissions Associated with Operation

Air Contaminant	Blasting	Excavating	On-Site Trucking	Crushing	Stockpiling	TOTAL
PM (tonnes/yr)	0.252	0.008	0.011	0.009	0.030	**0.31**
PM_{10} (tonnes/yr)	0.195	0.008	0.011	0.009	0.030	**0.25**
$PM_{2.5}$	0.182	0.008	0.011	0.009	0.030	**0.24**

Table 5.2.7: Annual Emissions Associated with Operation

Air Contaminant	Blasting	Excavating	On-Site Trucking	Crushing	Stockpiling	TOTAL
(tonnes/yr)						
CO (tonnes/yr)	0.010	0.020	0.027	0.022	0.075	**0.15**
NO_X (tonnes/yr)	0.048	0.094	0.131	0.104	0.360	**0.74**
$S0_2$ (tonnes/yr)	0.028	0.055	0.078	0.062	0.213	**0.44**
CO_2 (tonnes/yr)	44.670	87.015	122.015	96.856	334.844	**685.40**

Notes: Emission Factors from AP-42, Sections 11.9, 11.19, 13.2 and 13.3 (USEPA 2018)
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.

Based on the low magnitude of annual emissions estimates provided in **Table 5.2.7** above 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.

There are additional activities of blasting and crushing during the operation phase of the Project that have the potential to contribute to fugitive particulate matter emissions. Emissions of fugitive particulate matter associated with material movement during the construction phase are much higher than those anticipated during operation. This is due to the nature of the gypsum material and that the crushed material is still very coarse.

Emissions of combustion gases and fugitive particulate matter during the operation phase is expected to be very localized and minimal. Emissions associated with fuel combustion from operations are not expected have a substantive effect on air quality. Fugitive emissions of particulate matter will largely be localized to the activity at the site and primarily during blasting activities. 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 effect on air quality beyond the property boundary.

With respect to climate, total greenhouse gas emissions during construction are estimated to be 685 tonnes per year (as CO_2-equivalent), which represents less than 0.005% of New Brunswick's last reported total of 15.3 Mt. Given the relatively low magnitude of emissions, no further action is taken in the analysis as per the guidance provided in the document titled *Incorporating Climate Change Considerations in Environmental Assessment: General Guidance for Practitioners* (CEA Agency 2003).

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

very 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 east of the Project site. 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 very conservative prediction of anticipated noise levels arising from the Project. The results of the noise modelling during operation are presented in **Table 5.2.8**.

Table 5.2.8: 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 (East) (dBA)	
			Lmax	Leq		Lmax	Leq
Dozer	81.7	1,119	44.4	40.4	361	54.2	50.2
Excavator	80.7	381	52.8	48.8	1,183	42.9	38.9
Excavator	80.7	381	52.8	48.8	1,183	42.9	38.9
Front End Loader	79.1	1,119	41.8	37.8	361	51.6	47.6
Truck	76.5	1,119	39.1	35.2	361	49	45
Truck	76.5	381	48.5	44.5	1,183	38.7	34.7
Truck	76.5	381	48.5	44.5	1,183	38.7	34.7
Truck	76.5	381	48.5	44.5	1,183	38.7	34.7
Truck	76.5	381	48.5	44.5	1,183	38.7	34.7
Drilling	81.0	381	53	46.1	1,183	43.2	36.2
Crushing	85.0	381	57	54	1,183	47.4	44.4
TOTAL	-	-	**57**	**57.6**	-	**54.2**	**54.1**

The predicted sound pressure level at each modelled residential receptor were well below the daytime criterion of 65 dBA as a 1-hour Leq. The worst case modelling predicted nighttime 1-hour Leq at Receptor 1 was 57.6 dBA, which is just above the nighttime criterion 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 nighttime 1-hour Leq at Receptor 2 was within the nighttime criterion of 55 dBA.

Given the relative distance between Project activities and the nearest residential receptors, blasting activities are not expected to result in noticeable or measurable vibration levels that could cause property damage or nuisance at nearby residences. 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 very localized and minimal, using standard and site-specific mitigation as identified. Appropriate mitigative measures will be taken when required to ensure 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 modelled sound pressure levels related to on-site activities are not predicted to exceed the criteria for daytime or nighttime for both construction and operation.

Greenhouse gas emissions from the Project are not anticipated to materially contribute to overall emissions in the region and represent less than 0.005% of greenhouse gas emissions in the province.

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 all phases of the Project are rated not significant, with a high level of confidence. No 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 2017). 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 six months, anticipated to begin in the second quarter of 2019 (subject to the receipt of all approvals and permits required for the Project);
- Operation: beginning in approximately the fourth quarter of 2019, 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 61.81 ha (i.e., conservatively assumed to be the entirety of PID No. 00149013) 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 Hammond River to the east, south, and west and Route 820 to the north. The LAA includes the PDA and any 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 2017) 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 Hammond 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 southern New Brunswick, approximately 16 km east of the Town of Hampton and lies within the Hammond River watershed. The Hammond River ultimately discharges into the Kennebecasis River which is part of the lower Saint John River. The Hammond River has a total drainage area of approximately 513 km^2 (NBDOE 2007). The Hammond River originates in the Caledonia Highlands near the rural community of Hammondvale and runs in a westerly direction for a distance of approximately 40 km into the Kennebecasis River at Nauwigewauk/Darlings Island. The Hammond River flows from the eastern side of the LAA, around the south and flows away from the LAA towards the Kennebecasis River to the west.

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 105 m above mean sea level (m amsl) in the central portion of the Project site, and slopes downward to the east, south, and west towards the Hammond River (approximately 70 m amsl), and slopes upward in the north towards Route 820 (approximate maximum elevation of 99 m amsl).

A number of the wetlands are interconnected by small watercourses and unnamed tributaries of the Hammond 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**.

5.3.2.2 Groundwater Resources

The surficial geology of the LAA consists of Late Wisconsonian glaciofluvial sediments deposited consisting of hummocky, ribbed, and rolling ablation till, some lodgement till, clay, minor silt, sand, gravel, and boulders; generally consisting of 1.5 m in thickness (Rampton 1984). These are generally consistent with those findings during exploration drilling, in that overburden was between 6.1 m and 30.5 m in thickness and consisted of red/brown mud containing some sandstone pebbles, gravel, and boulders, and occasionally containing grey/green limestone pebbles and/or gravel. A shallow groundwater table may be present within this surficial material; however, it is likely localized and discontinuous across the PDA.

The bedrock geology of the area is made up of the Gays River Formation and the Macumber Formation. These formations are early Carboniferous aged, sedimentary deposits that form part of the Windsor Group. The Gays River Formation is grey to brown or black fossiliferous and algal limestones. The Macumber Formation is grey to black sparsely fossiliferous, interclastic and/or pelletoidal limestone with minor intraformational breccia (Barr and White 2004). Overlying these limestone units on the northern portion of the PDA is between 1.5 m and an unknown thickness of gypsum and anhydrite.

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 4.5 m in vertical thickness, indicating that subterranean karst features may also be present. Dissolution zones were also noted within the gypsum and anhydrite layers up to 5 m in vertical thickness. Dissolution zones where gypsum and anhydrite have washed away have been in-filled with layers of compact silt, clay, and sand. 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.

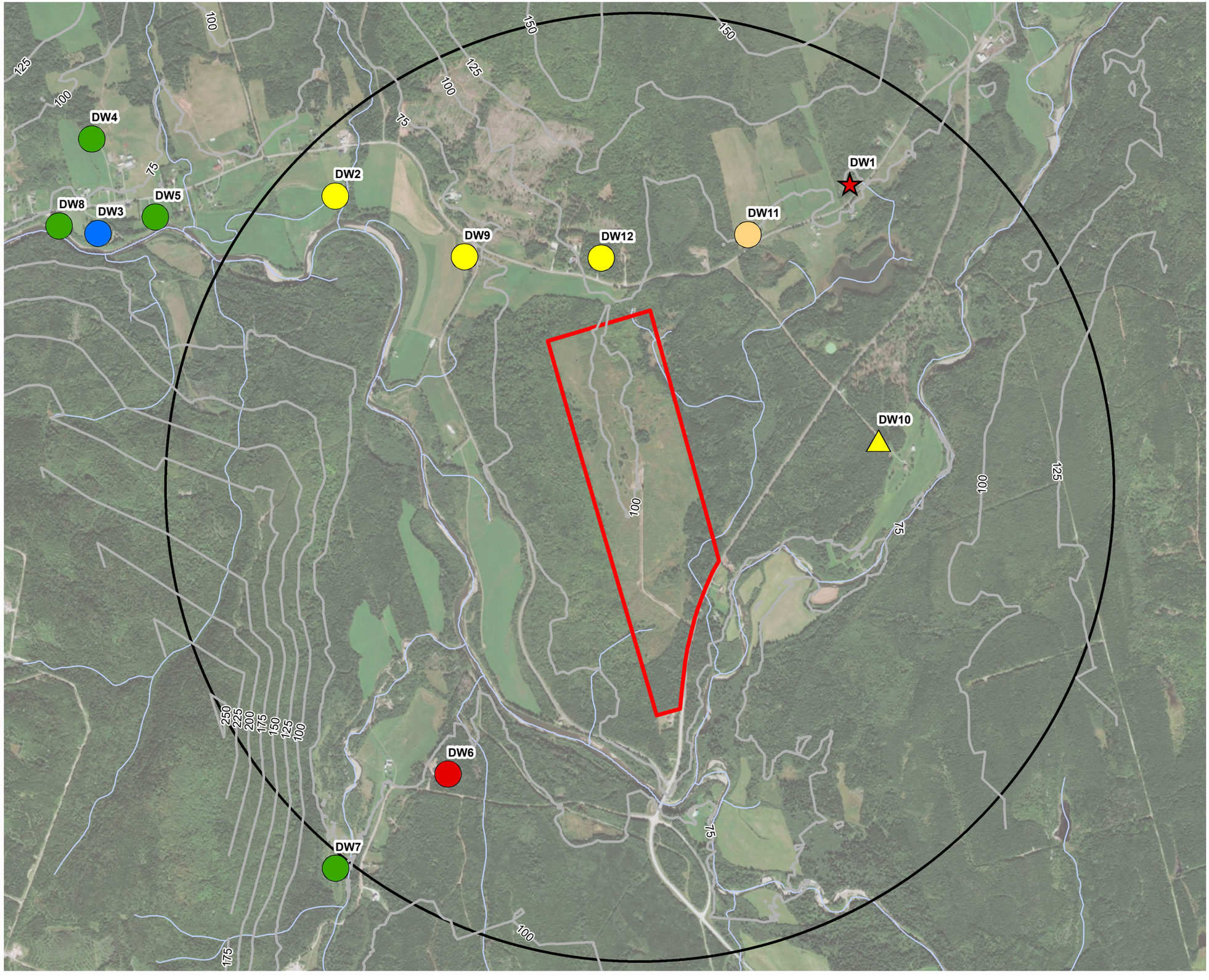
From a recharge to groundwater perspective, the PDA is situated at a topographic divide whereby precipitation in this area is draining to the east and west into the Hammond River. To gain a better understanding of the known sources of groundwater in the area, a desktop review of the New Brunswick Online Well Log System (OWLS; NBDELG 2018b) search was completed by Dillon. For the review (Dillon 2018), 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 12 water wells near or within the 2 km radius surrounding the subject property. Available information regarding well construction details are outlined below in **Table 5.3.1**.

Table 5.3.1: Well Construction Details For 12 Wells Within Approximately 2 km of the Project (NBDELG 2018b)

Well Identification	Overall Well Depth (m)	Well Casing Diameter (cm)	Well Casing Depth (m)	Estimated Safe Yield (L/min)[1]
DW1	21.34	25.4	6.1	3.41
DW2	68.58	15.24	20.12	22.75
DW3	32	15.24	12.19	136.5
DW4	45.72	15.24	12.19	52.32
DW5	83.82	15.24	6.1	31.85
DW6	30.48	15.24	12.19	0
DW7	30.48	15.24	9.14	31.85
DW8	44.2	15.24	11.58	45.5
DW9	15.24	15.24	12.19	27.3
DW10	53.34	15.24	12.19	13.65
DW11	45.72	15.24	20.42	6.82
DW12	42.67	15.24	12.19	20.48

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.



HAMMOND RIVER HOLDINGS LTD.
PROPOSED UPHAM EAST GYPSUM QUARRY

DOMESTIC WELL LOCATIONS
FIGURE 5.3.1

OBSERVED STRATIGRAPHY
- GYPSUM/SULPHATES
- GRANITE/IGNEOUS
- SHALE/SANDSTONE/SLATE

ESTIMATED SAFE YIELD (L/MIN)
- EXCELLENT (>60)
- VERY GOOD (30 - 60)
- GOOD (10 - 30)
- MARGINAL (5 - 10)
- INSUFFICIENT (0 - 5)
- SEARCH RADIUS (2 KM)
- PROJECT DEVELOPMENT AREA
- WATERCOURSES
- CONTOURS

0 125 250 500 m

SCALE 1:15,500

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

MAP CREATED BY: CS
MAP CHECKED BY: JH
MAP PROJECTION: NAD_1983_CSRS_New_Brunswick_Stereographic

FILE LOCATION: \\DILLON.CA\DILLON_DFS\FREDERICTON\FREDERICTON CAD\CAD\GIS\188346 UPHAM GYPSUM QUARRY\MXD

DILLON CONSULTING

PROJECT: 18-8346
STATUS: FINAL
DATE: OCT 2018

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: Observed Stratigraphy for 12 Wells Within Approximately 2 km of the Project (NBDELG 2018b)

Well Identification	Depth of Top of Zone (m)	Depth of Bottom of Zone (m)	Stratigraphy[1]
DW1	0	4.88	Brown Clay
	4.88	21.34	White Gypsum
DW2	0	0.91	Brown Topsoil
	0.91	4.88	Brown Sand and Gravel
	4.88	12.19	Brown Sand
	12.19	18.29	Red Clay
	18.29	68.58	Red Shale
DW3	0	9.14	Brown Sand and Gravel
	9.14	21.34	Red Shale
	21.34	24.38	Grey Shale
DW4	24.38	32	Red Shale
	0	6.1	Brown Mud and Stones
DW5	6.1	45.72	Red Sandstone
	0	1.52	Brown Mud and Gravel
	1.52	83.82	Red Sandstone
DW6	0	9.14	Brown Sand
	9.14	30.48	Grey Shale
DW7	0	3.05	Brown Mud
	3.05	30.48	Grey Slate
DW8	0	0.61	Brown Soil
	0.61	8.84	Brown Hardpan
	8.84	10.67	Brown Gravel
DW9	10.67	44.2	Brown Shale
	0	10.67	Red Clay and Gravel and Rock
DW10	10.67	15.24	Red Sandstone
	0	4.27	Brown Mud and Rock
	4.27	53.34	Grey Granite

Table 5.3.2: Observed Stratigraphy for 12 Wells Within Approximately 2 km of the Project (NBDELG 2018b)

Well Identification	Depth of Top of Zone (m)	Depth of Bottom of Zone (m)	Stratigraphy[1]
DW11	0	18.9	Red Clay and Mud
	18.9	45.72	Red Shale
DW12	0	10.06	Brown Clay
	10.06	42.67	Red 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.

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 12 Wells Within Approximately 2 km of the Project (NBDELG 2018b)

Well Identification	Water Bearing Zone Depth (m)	Estimated Water Flow Rate (L/min)[1]
DW1	21.34	3.41
DW2	53.34	4.55
	60.96	18.2
DW3	24.38	136.5
DW4	21.34	2.28
	38.1	4.55
DW5	42.06	45.5
	30.48	2.28
	60.96	2.28
	71.93	27.3
DW6	13.72	2.28
	27.43	29.58
DW7	10.67	13.65
	27.43	18.2
DW8	35.05	4.55
	42.98	40.95
DW9	13.72	27.3
DW10	50.29	13.65
DW11	22.86	2.28
	35.05	4.55

Table 5.3.3: Water Bearing Zones for 12 Wells Within Approximately 2 km of the Project (NBDELG 2018b)

Well Identification	Water Bearing Zone Depth (m)	Estimated Water Flow Rate (L/min)[1]
DW12	39.62	20.48

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 any reported water quality analytical data to its corresponding well. The OWLS search completed as part of this assessment yielded analytical data for 9 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 2017).

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 5.3.2**.

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 all 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 as though gypsum was encountered during the construction of DW1, and that DW1 is sourcing groundwater from this gypsum zone. It should be noted that this water bearing zone produces less than 4 L/min.
- The water quality analytical data indicate low-level detections of bromide (common constituent of sea water) in samples from Well 6 and Well 9. These detections of bromide could be attributed to relic seawater in the surrounding formation, or by dissolution in the bedrock geology.
- The topography of the study area suggests that groundwater is anticipated to flow from the site to the south/west/east towards the Hammond River. Elevation contours are displayed on **Figure 5.3.1**.
- Based on the available groundwater analytical data, various health-based and aesthetic objective-based exceedances were observed in samples from Well 4, Well 5, Well 6, and Well 8.

TABLE 5.3.4
GENERAL CHEMISTRY AND TRACE METALS - OWLS SURVEY ANALYTICAL DATA
Upham Gypsum Exploration Project
Upham, New Brunswick
Project No. 17-5121

Parameter	Units	GCDWQ 2014	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8	Sample 9
General Chemistry											
Sodium	mg/L	200**	63.3	3.41	4.45	14.2	12.8	78.6	8.83	5.4	3.33
Potassium	mg/L	NG	3.2	0.4	1.1	1.6	1.4	0.992	0.93	0.681	0.31
Calcium	mg/L	NG	99.2	50.1	49.2	20	27.1	7.68	94.01	37.5	45.8
Magnesium	mg/L	NG	3.81	1.11	2.75	2.16	2.11	0.343	4.4	2.1	1.76
Iron	mg/L	0.3**	0.295	<0.01	0.037	**3**	0.085	0.02	0.003	<0.05	0.016
Manganese	mg/L	0.05**	<0.005	<0.005	<0.005	**0.140**	0.047	<0.005	-	**0.052**	0.0068
Copper	mg/L	1**	<0.010	<0.010	<0.010	0.015	<0.010	0.037	-	<0.010	<0.010
Zinc	mg/L	5**	0.24	<0.005	<0.005	0.05	<0.005	0.019	-	<0.01	0.0098
pH	units	7-10.5*	8.05	7.56	7.96	7.16	8.24	8.46	8.08	7.9	8.2
Total Alkalinity	mg/L	NG	123	112	113	62.8	75.7	131	82.12	101	83.8
Chloride	mg/L	250**	78.3	4.55	5.07	2.8	3.54	8.31	4.89	4.13	3.38
Sulfate	mg/L	500**	147	4.09	4.22	11.1	19.4	38.4	165	15	45
Nitrate + Nitrite (as N)	mg/L	10* [A]	0.5	0.36	1.1	<0.05	<0.05	0.45	0.29	<0.05	0.07
Total Dissolved Solids	mg/L	NG	471.887	132.711	139.772	93.809	112.45	215.966	-	-	150.334
Conductivity	µS/cm	NG	799	254	273	154	208	383	530	228	283
Calculated Parameters											
Bicarbonate as $CaCO_3$	mg/L	NG	121.7	111.6	112	62.71	74.4	131	-	-	83.8
Carbonate as $CaCO_3$	mg/L	NG	1.3	0.4	1	0.0852	1.215	0	-	-	0.000
Hydroxide as $CaCO_3$	mg/L	NG	0.100	0.000	0.000	0.007	0.087	0.000	-	-	0.000
Cation sum	EPM	NG	8.125	2.754	2.911	2.0728	2.1375	3.861	-	-	2.587
Anion sum	EPM	NG	7.80	2.49	2.60	1.57	2.03	3.74	-	-	2.72
Theoretical Conductivity	µS/cm	NG	773.643	229.219	253.348	156.31	194.44	338.079	-	-	263.178
Hardness	mg/L	NG	263	130	134	58.8	76.4	20.6	252.9	102.3	122
Trace Metals											
Aluminum (Al)	µg/L	100**	<25	<25	51	**630**	**110**	<25	-	<25	<25
Antimony (Sb)	µg/L	6*	<1	<1	<1	<1	<1	**6.31**	-	<1	<1
Arsenic (As)	µg/L	10*	<1.5	<1.5	<1.5	<1.5	<1.5	**26.1**	3.1	<1	<1.5
Barium (Ba)	µg/L	1000*	53	160	291	139	100	24	25	101	212
Bromide (Br)	µg/L	NG	<100	<100	<100	<100	<100	124	-	<100	134
Boron (B)	µg/L	5000*	98	<10	21	121	124	159	60	<200	<10
Cadmium (Cd)	µg/L	5*	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.01	<0.05	<0.05
Calcium (Ca)	µg/L	NG	99200	50100	49200	20000	27100	7680	94010	37500	45800
Chromium (Cr)	µg/L	50*	<10	<10	<10	<10	<10	<10	3	11	<10
Copper (Cu)	µg/L	1000**	<10	<10	<10	15	<10	37	-	<10	<10
Iron (Fe)	µg/L	300**	295	<10	37	**3000**	85	20	3	<50	16
Fluoride (F)	µg/L	1500*	386	<100	<100	<100	<100	938	120	109	<100
Lead (Pb)	µg/L	10*	1.1	<1	<1	**13**	<1	3.29	-	<1	<1
Magnesium (Mg)	µg/L	NG	3810	1110	2750	2160	2110	343	4400	2100	1760
Manganese (Mn)	µg/L	50**	<5	<5	<5	**140**	47	<0.005	-	**52**	6.8
Potassium (K)	µg/L	NG	3200	400	1100	1600	1400	992	930	681	305
Selenium (Se)	µg/L	50*	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	-	<1	<1.5
Sodium (Na)	µg/L	200000**	63300	3410	4450	14200	12800	78600	8830	5400	3330
Thallium (Tl)	µg/L	NG	<1	<1	<1	<1	<1	<1	-	<1	<1
Uranium (U)	µg/L	20*	7.4	0.5	2.1	<0.5	<0.5	16	-	-	<0.5
Zinc (Zn)	µg/L	5000**	240	<5	<5	50	<5	19	-	<10	9.8

Notes:

* Health Canada Federal-Provincial-Territorial Committee on Canadian Drinking Water (FTP CDW) Guidelines for Canadian Drinking Water Quality (GCDWQ, 2017) Health Based Objective (HBO).

** Health Canada Federal-Provincial-Territorial Committee on Canadian Drinking Water (FTP CDW) Guidelines for Canadian Drinking Water Quality (GCDWQ, 2017) Aesthetic Based Objective (ABO).

[A] The GCDWQ 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/parameter not analyzed.
NG	denotes No Guideline established.
7,500	**BOLD**/shaded value denotes concentration exceeds GCDWQ HBO.
7,500	**BOLD**/shaded value denotes concentration exceeds GCDWQ ABO.

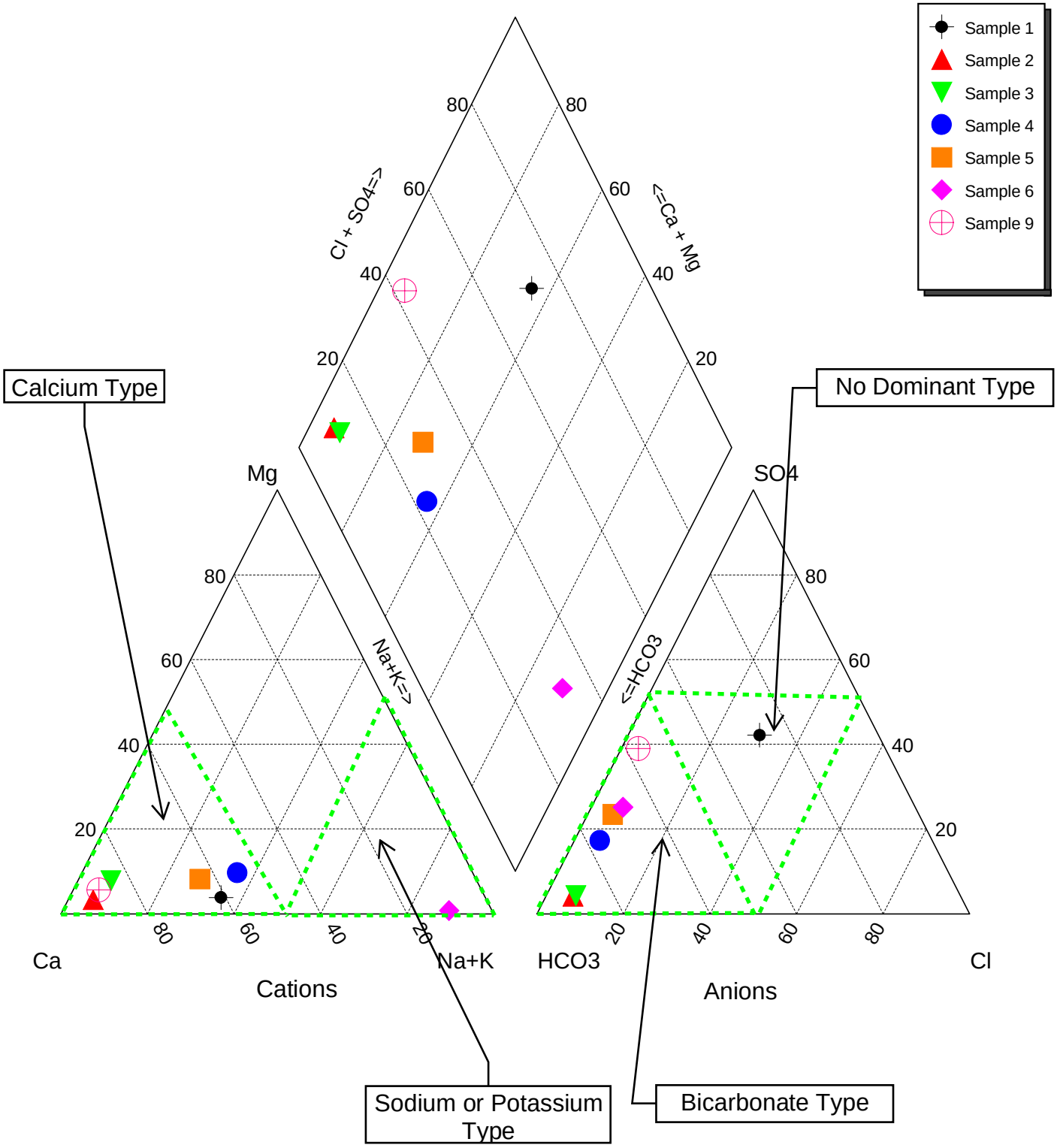


Figure 5.3.2: Groundwater Chemisty Trilinear Piper Plot

DILLON CONSULTING	PROJECT: Upham East Gypsum Quarry	PROJECT NO: 18-8346
	CLIENT: Hammond River Holdings Limited	DATE: October 2018

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 several 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 Hammond 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 releasing 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 be destroyed 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 through exposure of sulphide-rich rocks in oxidizing environments. However, not all sulphur-containing rocks generate acid under these conditions. Due to the chemical composition of gypsum and anhydrite, which do not contain sulphides, 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 mitigation 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 ensure 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**.
- It is planned that up to 20 potable wells in the LAA will be sampled 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 2017) 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.

5.3.3.3 Characterization of Residual Effects

From the beginning of operation, 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 Hammond River due to the following factors:

- the PDA and LAA comprise a small portion (i.e., 0.61 km^2) of the entire Hammond River watershed (i.e., 513 km^2);
- Following the creation of the open pit, surface water and groundwater will continue to discharge to the Hammond River;
- Current conditions onsite include a limited tree canopy due to the former forest harvesting activities; therefore, it is anticipated that surface water temperature conditions (i.e. bassline 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 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 ensure 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.

It is planned that up to 20 potable wells in the LAA will be sampled 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 2017) 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 all phases of the Project are rated not significant, with a moderate level of confidence.

Follow-up measures to be implemented including a water well sampling program and routine monitoring of discharge water quality and groundwater levels on site throughout the Project life, with associated adaptive management as required, will improve the level of confidence of this prediction.

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 First Nation 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 provincial *Fish and Wildlife Act* and the *Watercourse and Wetland Alteration Regulation* under the New Brunswick *Clean Water Act*. The federal *Fisheries Act* protects fish or fish habitat that are part of commercial, recreational or Aboriginal (CRA) fisheries, or that support such a fishery (DFO 2013). Section 35(2) of the *Fisheries Act* prohibits *serious harm to fish,* which is defined in the Act as "*the death of fish or any permanent alteration to, or destruction of, fish habitat*". 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 six months, anticipated to begin in the second quarter of 2019 (subject to the receipt of all approvals and permits required for the Project);
- Operation: beginning in approximately the fourth quarter of 2019, 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 61.81 ha (i.e., conservatively assumed to be the entirety of PID No. 00149013) 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 5.4.1**.

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 PDA, as well as a 500 m radius around the PDA that includes the Hammond River, as well as watercourses that extend off of the property and interconnect with tributaries of the Hammond River, or are connected to the main branch of the Hammond 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 or non-offset loss of fish habitat that results in “serious harm to fish” as defined under the *Fisheries Act*. For fish populations, a significant adverse residual environmental effect would result from a Project-related 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 Kings County in southeastern New Brunswick within the Hammond River watershed, which drains into the Kennebecasis and Saint John Rivers (Bradford et al. 2015). The Hammond River watershed drains an area of 513 km^2 where forestry and agriculture are the predominant land uses (NBDOE 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 Hammond River, which are generally associated with wetland features on the Project site.

Fish species that typically reside in the Hammond River include Atlantic salmon (*Salmo salar*), brook trout (*Salvelinus fontinalis*), smallmouth bass (*Micropterus dolomieu*), rainbow smelt (*Osmerus mordax*), striped bass (*Morone saxatilis*), and shortnose sturgeon (*Acipenser brevirostrum*) (NBDOE 2007). The Hammond River maintains an annual run of returning adult Atlantic salmon (outer Bay of Fundy population) (HRAA 2015). The outer 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); that designation is currently under review under the federal *Species at Risk Act* (SARA). The inner Bay of Fundy population of Atlantic salmon has been listed as "Endangered" under SARA.

The Hammond River Angling Association (HRAA) 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 (HRAA 2018).

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 Energy and Resource Development (NBDERD);
- 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", or "Threatened" 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.

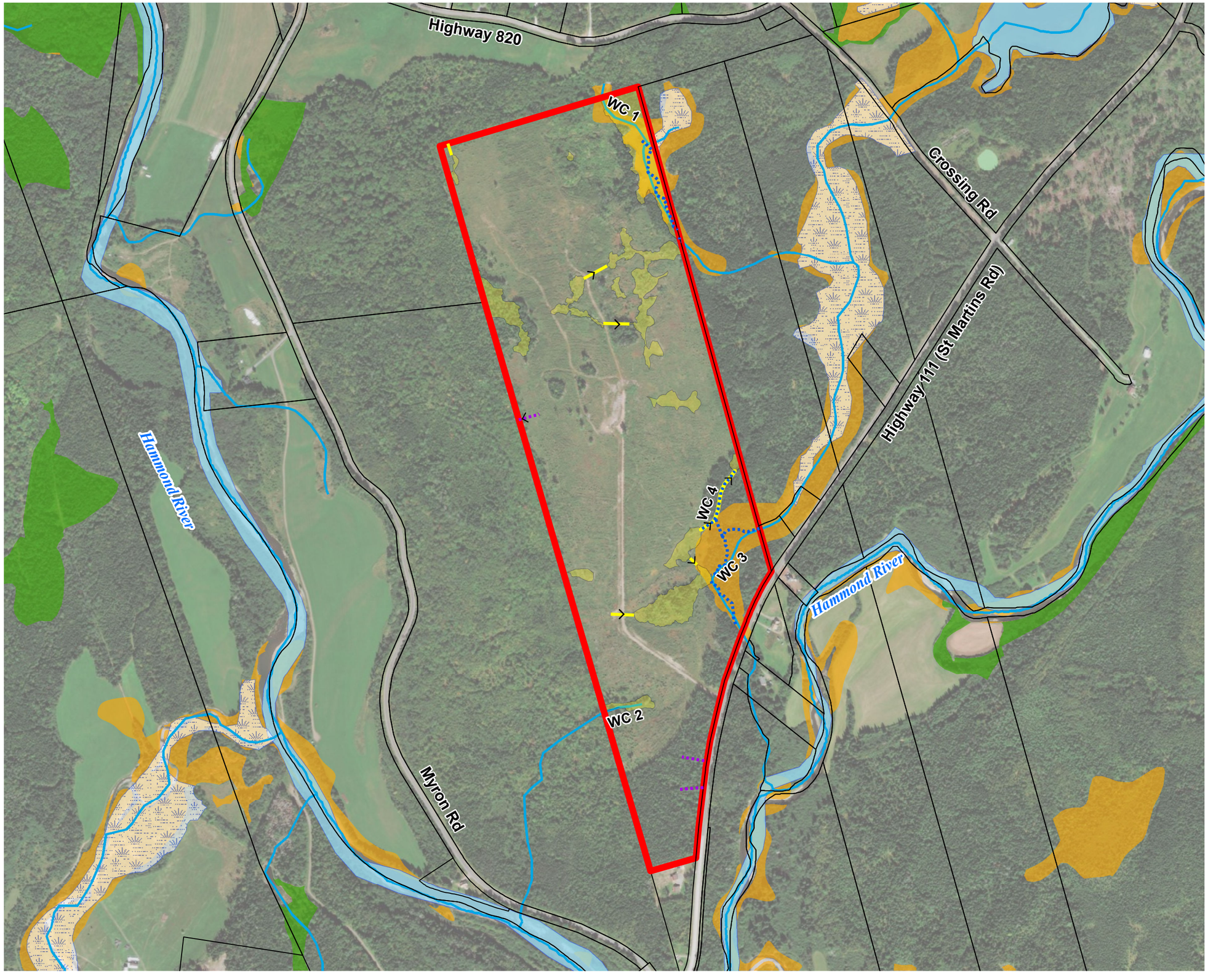
A custom Atlantic Canada Conservation Data Centre (AC CDC) (2018) data report (refer to **Appendix A**) was obtained for a 5 km radius around the PDA. According to the AC CDC records review, there is one record of aquatic SAR that has been historically observed within 5 km of the Project: the Atlantic salmon (*Salmo salar)* outer Bay of Fundy population is ranked as S2 (rare) by the AC CDC and is also listed as "Endangered" by COSEWIC but is not listed under SARA or NB SARA. In addition, the DFO aquatic species at risk mapping (DFO 2018) identified shortnose sturgeon (*Acipenser brevirostrum*) (listed as "Special Concern" under Schedule 1 of SARA) as potentially occurring within the Hammond River. Although there are no identified critical habitat or sightings of shortnose sturgeon in the Hammond River (a sub-drainage of the Kennebecasis River), the Kennebecasis River is known as an overwintering ground location (DFO 2018).

Additionally, there is one managed area, the Hanford Porters Brook Sandstone Beds 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 5.4.1**). These small unnamed tributaries to the Hammond River are associated with wetland features on the Project site.

5.4.2.3 Field Assessment

A field assessment of fish and fish habitat in the PDA was conducted on August 29-30, 2018 by Dillon biologists experienced in conducting aquatic/fish habitat surveys. A member of Tobique First Nation (TFN) worked with Dillon's biologists during the field surveys to provide a traditional knowledge perspective. During the assessment, three mapped watercourses (identified as Watercourse 1 (WC1), WC2, and WC3) and one unmapped watercourse (WC4) were identified (**Figure 5.4.1**). Based on the knowledge of the member of TFN, the Project area did not offer unique aquatic habitat or contain fish species of special significance to traditional activities or uses. Traditional activities such as fishing and trapping that may occur within the Hammond River could continue in the area subsequent to the development of the proposed Project. The detailed methods and results for fish and fish habitat assessments of WC1 to WC4 are summarized in the following sections.



HAMMOND RIVER HOLDINGS LTD.
PROPOSED UPHAM EAST GYPSUM QUARRY

FISH HABITAT
FIGURE 5.4.1

- PROPERTY BOUNDARY
- PROJECT DEVELOPMENT AREA
- GEO NB MAPPED WATERCOURSE
- FIELD DELINEATED WETLANDS
- FIELD IDENTIFIED DRAINAGE CHANNEL
- FIELD IDENTIFIED WATERCOURSE
- FIELD IDENTIFIED WETLAND DRAINAGE CONNECTION (WITH FLOW DIRECTION ARROW)
- REGULATED WETLAND

NBDELG DRAFT BETA WETLAND MAPPING (UNREGULATED)

- PROVINCIALLY SIGNIFICANT WETLANDS
- INTERMEDIATE WETLANDS
- FORESTED WETLANDS

WC = WATERCOURSE

0 50 100 200 m

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: BQS
MAP REVISED BY: JH
MAP CHECKED BY: AS
MAP PROJECTION: NAD_1983_CSRS_New_Brunswick_Stereographic

FILE LOCATION: \\DILLON.CA\DILLON_DFS\FREDERICTON\FREDERICTON CAD\CAD\GIS\188346 UPHAM GYPSUM QUARRY\MXD

DILLON CONSULTING

PROJECT: 18-8346
STATUS: FINAL
DATE: OCT 2018

Fish Habitat Assessment

The aquatic habitat assessment was conducted using sampling protocol based on the NBDERD (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 all 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, three mapped watercourses (WC1, WC2, and WC3) and one unmapped watercourse (WC4) were identified, as well as two small drainage connections between WL4 and WL5 (refer to **Section 5.5** for wetland descriptions). The Hammond River Angling Association (HRAA) has collected extensive water quality and fish and fish habitat data for the Hammond Rive over several years, and given that the Hammond River is located more than 100 m from the PDA and will not be directly affected by the Project, a field survey of the Hammond River was not considered to be required. It is noted that substantial historical data for the Hammond River are available from thee Hammond River Angling Association.

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

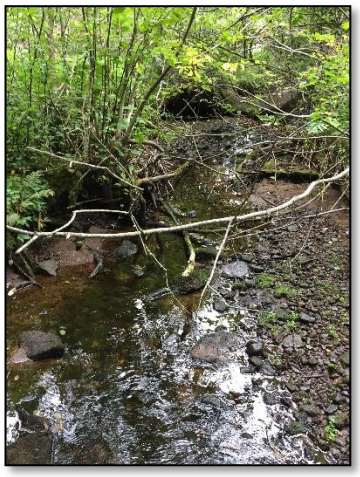
Watercourse ID	Representative Photo	Average Stream Dimensions (m)	Dominant Aquatic Habitat Type and Other Observations
WC1 – Unnamed (Mapped) Tributary to Hammond River		**Wet Width:** 1.44 m **Bankfull Width:** 2.7 m **Average Depth:** 0.17 m	Small watercourse with good run/pool (fish) habitat associated with WL3. Fish were observed during the field survey. **Dominant Substrate:** 10% Cobble, 60% Gravel, 20% Sand, 10% Silt
WC2 – No Defined Channel (though Mapped)		**Wet Width:** N/A **Bankfull Width:** N/A	**Fish Habitat Suitability:** Not fish habitat. Drainage area of field identified WL9 with no defined channel in the PDA.
WC3 – Unnamed (Mapped) Tributary to Hammond River		**Wet Width:** 1.8 m **Bankfull Width:** 2.96 m **Average Depth(s):** 0.13 m	**Fish Habitat Suitability:** A fish-bearing watercourse with run and pool habitats. Brook trout present. Drainage input from WL8, WL11, and WC4. **Dominant Substrate:** 65% Cobble, 25% Gravel, 10% Sand

Table 5.4.1: Summary of Watercourse Characteristics

Watercourse ID	Representative Photo	Average Stream Dimensions (m)	Dominant Aquatic Habitat Type and Other Observations
WC4 – Dry drainage channel (Unmapped)		**Wet Width:** 0.78 m **Bankfull Width:** 0.85 m **Average Depth(s):** N/A (dry at time of survey)	**Fish Habitat Suitability:** Intermittent stream/Wetland Drainage connected to WC3, WL11, and WL12. Not fish habitat (no fish observed at the time of survey). **Dominant Substrate:** 25% Cobble, 20% Gravel, 15% Sand, 40% Silt

Unnamed Tributary to Hammond River – Watercourse 1 (WC1) – WC1 is a mapped watercourse determined to be a small fish-bearing stream during the field survey, which flows through a GeoNB mapped wetland (WL3). The upstream reach of the watercourse near the northeast boundary of the PDA is in a former beaver impoundment, while the downstream reach consists of run/pool habitat in softwood dominant forest. The upper reach within the former beaver impoundment provides little overhead cover with the bank vegetation consisting of only grasses, but has moderate amount of submerged woody debris which provides instream cover for fish. The substrate in the upstream reach consisted of mostly fines, sand and small amounts of gravel. The downstream reach below the old beaver dam impoundment provides more overhead canopy cover for fish with shrubs and trees as the dominant bank vegetation, but has very little submerged woody debris for instream cover. The substrate in the downstream reach was dominated by gravel and sand with some cobble and fines. Fish (minnows) were observed during the assessment.

Unnamed Tributary to Hammond River (No Defined Channel) – Watercourse 2 (WC2) – WC2 is a mapped watercourse located in the southwest side of the PDA which was characterized during the field survey as a wetland drainage of field-identified wetland WL9. No defined channel or fish were observed during the field survey within the PDA.

Unnamed Tributary to Hammond River – Watercourse 3 (WC3) – WC3 is a small mapped fish-bearing stream located near the southeast boundary of the PDA. The mapped watercourse has an average wetted width of 1.8 m and bankfull width of 2.98 m. The surveyed portion of WC3 was approximately 300 m long and consisted mainly of run habitat with a few small pools. The dominant substrates were cobble (65%), gravel (25%), and sand (10%). Bank vegetation consisted of grasses (25%), shrubs (20%), and trees (5%), which provided a good amount of overhead canopy cover (approximately 41-70 %). Fish (brook trout and minnows) were observed during the field survey.

Field Identified (Unmapped) Dry Drainage Channel (Unnamed Tributary to WC3) – Watercourse 4 (WC4) – WC4 is a field-identified (unmapped) intermittent stream with a defined channel that was completely dry at the time of the survey. The drainage channel is connected to WL11, WL12, and WC3, and would likely contain water during spring melt and high runoff events. No fish were present at the time of the survey.

Fish Presence Assessment

Qualitative fish presence assessments using backpack electrofishing techniques were conducted in the mapped and field-identified (unmapped) 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 technicians to recover the fish using with dip nets. Unit settings ranged from 150 to 250 V and frequency of 40 to 60 Hz, depending on the conductivity of the watercourse and observed fish response. Fish presence surveys were completed in WC1 and WC3 on August 29 and 30, 2018, respectively. Electrofishing surveys of WC2 (no defined channel) and WC4 (dry at the time of the field survey) could not be conducted.

Based on the qualitative electrofishing surveys, fish species detected in WC1 included common white sucker (*Catostomus commersoni*), blacknose dace (*Rhinichthys atratulus*), and creek chub (*Semotilus atromaculatus*), which are typical species of warm ("cool") water streams.

Fish species present in WC3 included brook trout (*Salvelinus fontinalis*), blacknose dace, creek chub, and common white sucker. Salmonids (such as brook trout and Atlantic salmon) 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).

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 at WC1 and WC3 located within the PDA. WC2 was determined to have no defined channel or open water within the PDA, and WC4 was dry at the time of the field survey, thus water quality could not be determined. In-situ measurements were recorded for water temperature (°C), conductivity (µS/cm), dissolved oxygen (DO) (mg/L and %), total dissolved solids (TDS), and pH. Water clarity and water level were also characterized at each watercourse using a visual assessment.

In addition, water samples were collected from each of the identified watercourses and submitted to the Research and Productivity Council (RPC) laboratory in Fredericton, New Brunswick for analysis of the following parameters:

- General chemistry (including total organic carbon, turbidity, alkalinity, hardness, pH, nitrate and nitrite, total ammonia, sulphate, chloride, and fluoride); and,

- Trace metals (full metal scan, including: aluminum, cadmium, cobalt, copper, iron, nickel, lead, vanadium, zinc, and mercury).

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 measurement and analytical results for water quality of WC1 and WC3 are presented in **Table 5.4.2**. Based on the results of water quality measurements collected in WC1 and WC3, there were no exceedances of the CCME FWAL guidelines. High conductivity levels were observed in WC1 at the time of the field survey (refer to **Table 5.4.2**), which can likely be attributed to the close proximity of WC1 to the gypsum deposit. WC1 and WC3 had relatively warm temperatures, which would be expected in slow-flowing first order tributaries. Low DO levels and warmer temperatures observed in both WC1 and WC3 denotes that the water quality is less suitable for cold water fish species but is suitable for more tolerant species observed during the surveys (NBDELG 2012). The low DO values were below the CCME FWAL (early life stages require a 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		
			WC1	WC3	Duplicate (WC3B)
General Chemistry					
Sodium	mg/L	NA	3.38	6.48	6.24
Potassium	mg/L	NA	0.47	0.65	0.62
Calcium	mg/L	NA	450	121	114
Ammonia (as N)	mg/L	41 [2]	<0.05	<0.05	<0.05
pH		6.5 - 9.0	7.3	7.6	7.5
Alkalinity (as $CaCO_3$)	mg/L	NA	64	56	56
Chloride	mg/L	120	4.3	10.8	9.3
Fluoride	mg/L	0.12	-	-	-
Sulphate	mg/L	NA	1,010	240	250
Nitrate + Nitrite (as N)	mg/L	NA	<0.25	0.12	0.12
o-Phosphate (as P)	mg/L	NA	<0.01	<0.01	<0.01
r-Silica (as SiO_2)	mg/L	NA	4.2	2.6	2.6
Carbon - Total Organic	mg/L	NA	3.9	7.3	7.5

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

Parameter	Units	CCME FWAL [1] (Long-Term)	Sample ID		
			WC1	WC3	Duplicate (WC3B)
Turbidity	NTU	2	0.2	0.3	0.3
Conductivity	µS/cm	NA	1,720	625	625
Calculated Parameters					
Bicarbonate (as $CaCO_3$)	mg/L	NA	63.9	55.8	55.8
Carbonate (as $CaCO_3$)	mg/L	NA	0.12	0.209	0.166
Hydroxide (as $CaCO_3$)	mg/L	NA	0.01	0.02	0.016
Cation sum	meq/L	NA	22.8	6.47	6.1
Anion sum	meq/L	NA	22.4	6.43	6.59
Percent difference	%	NA	0.87	0.29	-3.9
Theoretical Conductivity	µS/cm	NA	2,140	687	680
Hardness (as $CaCO_3$)	mg/L	NA	1,130	308	290
Ion Sum	mg/L	NA	1,510	418	419
Saturation pH (5°C)	units	NA	7.4	7.9	7.9
Langelier Index (5°C)	units	NA	-0.07	-0.26	-0.38
Trace Metals					
Aluminum [2]	µg/L	100	16	14	14
Antimony	µg/L	NA	<0.1	<0.1	<0.1
Arsenic	µg/L	5	<1	<1	<1
Barium	µg/L	NA	66	33	31
Beryllium	µg/L	NA	<0.1	<0.1	<0.1
Bismuth	µg/L	NA	<1	<1	<1
Boron	µg/L	1,500	144	38	38
Cadmium	µg/L	0.09	0.02	<0.01	<0.01
Calcium	µg/L	NA	450,000	121,000	114,000
Chromium	µg/L	1	<1	<1	<1
Cobalt	µg/L	NA	<0.1	<0.1	<0.1
Copper	µg/L	2	1	<1	<1
Iron	µg/L	300	130	80	80
Lead	µg/L	1	<0.1	<0.1	<0.1
Lithium	µg/L	NA	0.7	0.3	0.3

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

Parameter	Units	CCME FWAL [1] (Long-Term)	Sample ID		
			WC1	WC3	Duplicate (WC3B)
Magnesium	µg/L	NA	2,410	1,500	1,430
Manganese	µg/L	NA	55	37	39
Mercury	µg/L	0.026	<0.025	<0.025	<0.025
Molybdenum	µg/L	73	0.2	0.2	0.2
Nickel	µg/L	25	<1	<1	<1
Potassium	µg/L	NA	470	650	620
Rubidium	µg/L	NA	0.8	1.4	1.3
Selenium	µg/L	1	<1	<1	<1
Silver	µg/L	0.25	<0.1	<0.1	<0.1
Sodium	µg/L	NA	3,380	6,480	6,240
Strontium	µg/L	NA	1,780	431	412
Tellurium	µg/L	NA	<0.1	<0.1	<0.1
Thallium	µg/L	0.8	<0.1	<0.1	<0.1
Tin	µg/L	NA	<0.1	<0.1	<0.1
Uranium	µg/L	15	0.3	<0.1	<0.1
Vanadium	µg/L	NA	<1	<1	<1
Zinc	µg/L	7	1	<1	<1
In-situ water quality measurements					
Temperature	°C	NA	17.0	18.1	NA
pH		6.5 - 9.0	7.07	7.33	NA
Specific Conductivity	µS/cm	NA	1,689	620	NA
Total dissolved solids (TDS)	mg/L	NA	1,099	403	NA
Dissolved oxygen (DO)	mg/L	9.5	5.00	6.76	NA
Dissolved oxygen (DO)	%		53.8	71.5	NA
Water Clarity	"Poor, moderate, fair"	NA	Fair	Fair	NA
Water Level	"low, moderate, fair"	NA	Low	Low	NA

[1] CCME (1999)

[2] The guideline for ammonia is temperature and pH dependent.

[3] Guidelines for cadmium, copper, lead, and nickel are variable depending on water hardness. Guideline was calculated using lowest value of hardness of 6.3 mg/L.

A value in **bold** denotes an exceedance of the applicable CCME FWAL guideline.
NA indicates not available.

Concentrations of all parameters in the water samples met the CCME FWAL guidelines, where such guidelines exist.

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 wetlands and 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 untreated surface water, or out of specification treated water, 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(s) 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 any alterations of watercourses and their 30 m buffers;
- Obtaining an authorization under Section 35(2) of the *Fisheries Act* for any Project activities that would result in the loss of fish habitat or other activities that result in serious harm to fish (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/wetland buffer; in particular, existing treed buffers surrounding watercourses and wetlands located on the southeastern and southwestern portions of 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;
- Release of 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;
- 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 ensure 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 watercourse 3 (WC3) that intersect the PDA, to allow for the construction of the open pit and related surface facilities to be located on the site. 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 (except for WC1 in the open pit area, for which the portion of WC1 that is present in the PDA will be lost), to minimize the extent of fish habitat loss.

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 pit sump and 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, WC3, and WC4), and given that the Hammond River is located more than 100 m from the nearest portion of the PDA, potential environmental effects to the Hammond River itself are not expected.

The direct and indirect loss of fish habitat that is deemed by DFO to result in serious harm to fish will be authorized under Section 35(2) of the *Fisheries Act* (with appropriate offsetting to achieve no net loss of fish productivity, as measured by habitat area) prior to beginning the Project. Additionally, a WAWA permit will be obtained for any 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 ensure 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 Hammond River and watershed), these effects are not expected to be measurable nor to affect fish and fish habitat.

The release of untreated surface water, or treated 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 a small quantity of emulsion explosives (a viscous liquid) stored on-site and 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 all phases 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 2018) 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 any alteration within 30 m of the banks of a watercourse or regulated wetland.

5.5.1.1 Temporal Boundaries

The temporal boundaries for the Project include the following:

- Construction: extending for a period of approximately six months, anticipated to begin in the second quarter of 2019 (subject to the receipt of all approvals and permits required for the Project);
- Operation: beginning in approximately the fourth quarter of 2019, 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) 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 61.81 ha (i.e., conservatively assumed to be the entirety of PID No. 00149013) 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 vegetation and wetlands, the LAA includes the PDA and any nearby wetlands whose catchment areas would include any 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

5.5.2.1 Regional Setting

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.

The PDA and LAA are located within the Valley Lowlands ecoregion and, more specifically, within the Anagance ecodistrict, which hosts rugged terrain consisting of steep river valleys that bisect rugged hills and mountains (Zelazny 2007). This ecoregion is characterized by dramatic influence of major watercourses and large lakes (Zelazny 2007). The interaction of flood events through these major watercourses with the varied topography of the ecoregion creates a wide spectrum of flood and substrate conditions, with a corresponding diversity of wetland types (Zelazny 2007).

Within this ecoregion, tolerant hardwood stands dominated by American beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*) and yellow birch (*Betula alleghaniensis*) sit on ridge tops with fertile soils. On less fertile ridges, hardwoods tend to be dominated by American beech, red maple (*Acer rubrum*), and trembling aspen (*Populus tremuloides*). Softwood forests in the area tend to be associated with lower slopes and shallow soils. The softwood forests are dominated by red spruce (*Picea rubens*), balsam fir (*Abies balsamea*), and white spruce (*Picea glauca*), with occasional Eastern hemlock (*Tsuga canadensis*) and white pine (*Pinus strobus*) (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 2018);
- New Brunswick Department of Energy and Resource Development (NBDERD) and NBDELG publications;
- The federal species at risk 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,
- Hammond River Angling Association 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 2018), there were no records of vascular or non-vascular plant species, including SAR or SOCC historically observed within a 5 km radius of the PDA. The lack of AC CDC data suggests a data gap for this area. Although there were no historical records of vegetation, including SOCC or SAR within the PDA, there is potential for their occurrence within the PDA, especially within more high value (i.e., less altered) habitats such as wetlands.

According to the New Brunswick forest inventory (i.e., publicly available GeoNB GIS database) the forest types within the LAA consist of typical forest types including softwood forests consisting of primarily balsam fir (*Abies balsamea*), and spruce (*Picea* spp.), within stands of tolerant hardwoods, intolerant hardwoods and mixedwood. There was no publicly available forest inventory data for the PDA. The upland habitats within the PDA consist of mainly areas of regenerating softwood and hardwood forest, as the property was cut-over in 2010.

5.5.2.3 Wetland Determination, Delineation, and Functional Assessment

Vegetation and wetlands in the PDA were surveyed by Dillon biologists certified in wetland delineation and functional assessments in New Brunswick from August 14 to 16, 2018. 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 (USACE 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 all 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 assure 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.

Hydric Soils

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 (rotten egg odour), among many other indicators. Interpretation of soil profiles, their associated colour, texture and presence/absence of any 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 every 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 (10 m, 5 m and 2 m radius, respectively) and their wetland indicator status (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 2018c). 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 2018c). **Table 5.5.1** provides a list of various functions, their definitions, and potential benefits.

Table 5.5.1: 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	Maintain quality of receiving waters. Protect shoreline structures from erosion.

Table 5.5.1: Benefits of Wetland Functions Scored by WESP-AC

Function	Definition	Potential Benefits
	excessive erosion, and stabilizing underlying sediments or soil	
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.
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 (2018)

During the field analysis conducted between August 14 and 16, 2018, 13 unmapped wetlands were identified, delineated and functionally assessed within the PDA (refer to **Figure 5.5.1**). The delineated wetlands are summarized in **Table 5.5.2**, below.

Table 5.5.2: Summary of Wetland Findings

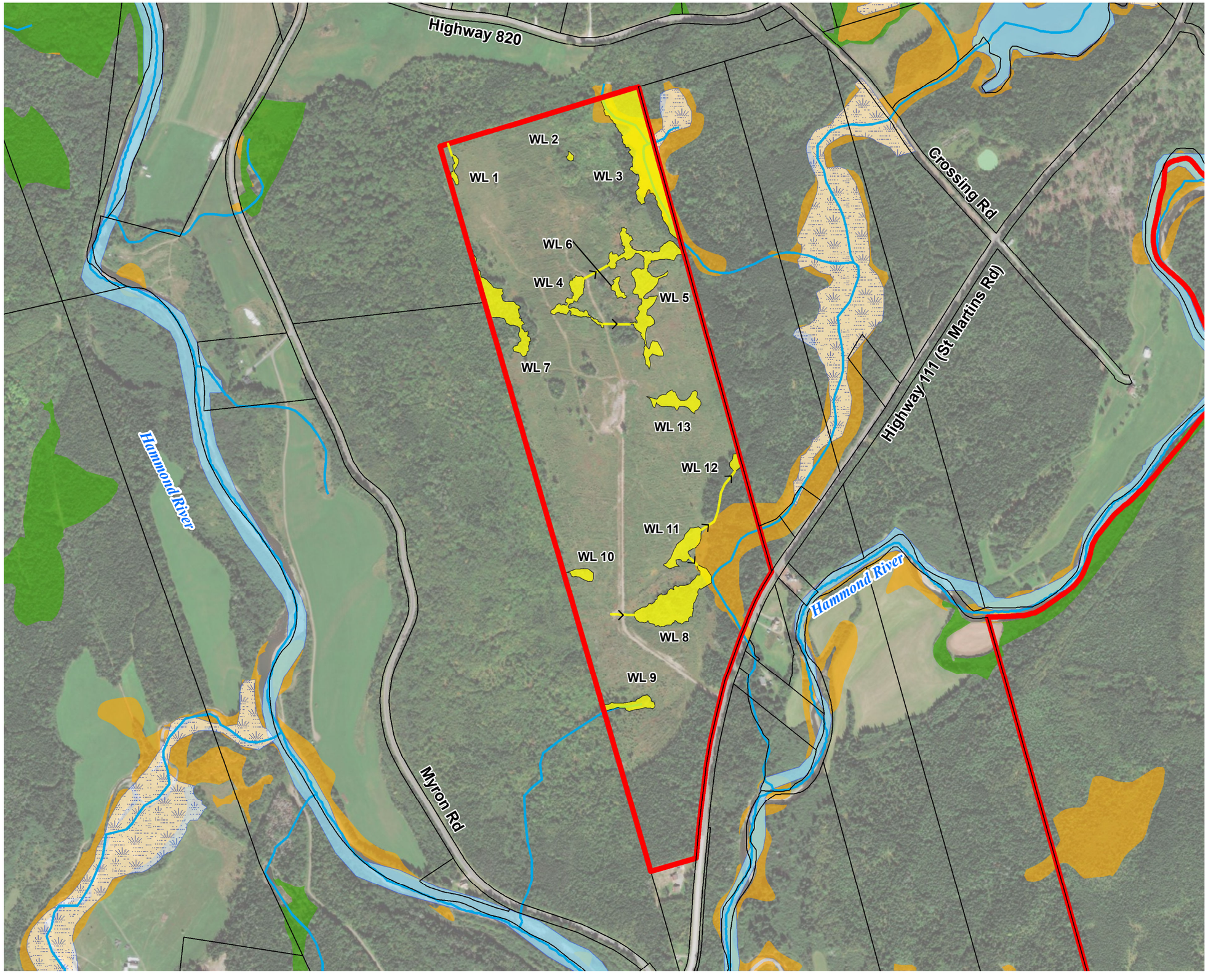
Wetland Identifier	Wetland Type	Key Wetland Functions[1]	Delineated Area (ha)	Area (ha) of Wetland to be Potentially Affected by the Project activities
Wetland 1 (WL1)	Shrub Swamp	Water Storage & Delay, Sediment Retention & Stabilisation, Aquatic Invertebrate Habitat	0.06	0.06
Wetland 2 (WL2)	Vernal Pond	Water Storage & Delay, Sediment Retention & Stabilisation, Phosphorus Retention, Nitrate Removal & Retention, Amphibian & Turtle Habitat, Waterbird Feeding Habitat, Waterbird Nesting Habitat	0.02	0.02
Wetland 3 (WL3)	Fen/ Wet Meadow complex	Organic Nutrient Export, Anadromous Fish Habitat, Resident Fish Habitat, Waterbird Feeding Habitat, Waterbird Nesting Habitat, Songbird, Raptor, & Mammal Habitat, Pollinator Habitat, Native Plant Habitat	1.8	1.8
Wetland 4 (WL4)	Bog	Water Storage & Delay, Sediment Retention & Stabilisation, Nitrate Removal & Retention, Songbird, Raptor, & Mammal Habitat, Pollinator Habitat	0.30	0.30
Wetland 5 (WL5)	Bog/ Wet Meadow complex	Songbird, Raptor, & Mammal Habitat, Pollinator Habitat	1.09	1.09
Wetland 6 (WL6)	Bog	Water Storage & Delay, Sediment Retention & Stabilisation, Phosphorus Retention, Nitrate Removal & Retention, Carbon Sequestration, Organic Nutrient Export, Aquatic Invertebrate Habitat	0.07	0.07

Table 5.5.2: Summary of Wetland Findings

Wetland Identifier	Wetland Type	Key Wetland Functions[1]	Delineated Area (ha)	Area (ha) of Wetland to be Potentially Affected by the Project activities
Wetland 7 (WL7)	Shrub Swamp	Water Cooling, Organic Nutrient Export, Songbird, Raptor, & Mammal Habitat, Pollinator Habitat	0.68	0.68
Wetland 8 (WL8)	Treed Swamp	Organic Nutrient Export, Songbird, Raptor, & Mammal Habitat, Pollinator Habitat, Native Plant Habitat	0.93	0
Wetland 9 (WL9)	Treed Swamp	Songbird, Raptor, & Mammal Habitat, Pollinator Habitat, Native Plant Habitat	0.19	0
Wetland 10 (WL10)	Shrub Swamp	Water Storage & Delay	0.10	0.10
Wetland 11 (WL11)	Shrub Swamp/ Wet Meadow complex	-[2]	0.31	0.31
Wetland 12 (WL12)	Shrub Swamp	Organic Nutrient Export, Resident Fish Habitat, Songbird, Raptor, & Mammal Habitat, Pollinator Habitat	0.08	0.08
Wetland 13 (WL13)	Wet Meadow	-[2]	0.27	0.27
		Total Wetland Area	**5.90**	**4.78**

Notes:

1. Key wetland functions are those functions that scored as 'higher' during the WESP-AC. Refer to detailed WESP-AC results in Appendix B.
2. The WESP-AC functional assessment for this wetland did not identify higher scoring functions. The functions for this wetland scored low and moderate.



HAMMOND RIVER HOLDINGS LTD.
PROPOSED UPHAM EAST GYPSUM QUARRY

WETLANDS
FIGURE 5.5.1

- PROPERTY BOUNDARY
- PROPERTY OWNED BY J D IRVING LIMITED
- GEO NB MAPPED WATERCOURSE
- FIELD DELINEATED WETLANDS
- FIELD IDENTIFIED WETLAND DRAINAGE CONNECTION (WITH FLOW DIRECTION ARROW)
- REGULATED WETLAND

NBDELG DRAFT BETA WETLAND MAPPING (UNREGULATED)

- PROVINCIALLY SIGNIFICANT WETLANDS
- INTERMEDIATE WETLANDS
- FORESTED WETLANDS

WL = WETLAND

0 50 100 200 m

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: BQS
MAP REVISED BY: JH
MAP CHECKED BY: AS
MAP PROJECTION: NAD_1983_CSRS_New_Brunswick_Stereographic

FILE LOCATION: \\DILLON.CA\DILLON_DFS\FREDERICTON\FREDERICTON CAD\CAD\GIS\188346 UPHAM GYPSUM QUARRY\MXD

DILLON CONSULTING

PROJECT: 18-8346
STATUS: FINAL
DATE: OCT 2018

The following sections provide a summary of the wetland delineation and functional assessment results for unmapped wetlands located within the PDA. There were no mapped (regulated) wetlands located within the PDA; the nearest mapped wetland is located on the adjacent property to the northeast of the site. Further details of the wetland's primary and secondary indicators and attributes as well as WESP-AC functional assessment results are presented within wetland profile sheets presented within **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 the wetlands that are present entirely within the PDA (i.e., unmapped wetlands) 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) – 0.06 ha Unmapped Shrub Swamp



Based on the results of the field assessment, Wetland 1 is characterized as a 0.06 ha outflow shrub swamp that is seasonally saturated and located on a slope (i.e., terrene position). This outflow wetland drains northward, out of the PDA into a mature mixed forest habitat as shown in **Figure 5.5.1**. Due to recent cut-over, there is no overstory (trees) within the wetland. The shrub layer was dominated by white meadowsweet (*Spiraea alba),* steeplebush (*Spiraea tomentosa)*, and red maple (*Acer rubrum).* The herbaceous understory layer was dominated by woolgrass (*Scirpus cyperinus*), grass-leaved goldenrod (*Euthamia graminifolia*), narrow-leaved cattail (*Typha angustifolia*), marsh bedstraw (*Galium palustre*), and necklace sedge (*Carex projecta*). The vegetation community identified at Wetland 1 (shrub swamp) is comprised of greater than 50% wet adapted vegetation species based on their indicator status (i.e., FAC, FACW, OBL) (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 the 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 soil close to the surface indicating that the water table regularly moves into this layer of the soil. The origin of the wetland is unknown and is possibly the result of tree removal and soil compaction from past forestry activities.

Wetland 2 (WL2) – 0.02 ha Unmapped Vernal Pool

Based on the results of the field assessment, Wetland 2 is characterized as a 0.02 ha isolated and seasonally flooded vernal pool located within what is expected to be a gypsum depression. Due to recent cut-over, there is no overstory (trees) within the wetland. The shrub layer was dominated by red osier dogwood (*Cornus sericea)* and common elderberry (*Sambucus nigra*). The herbaceous understory layer was dominated by common spikerush (*Elelocharis palustris*), woolgrass, and slender manna-grass (*Glyceria melicaria*). There were no flora SAR or SOCC observed during the desktop or field delineations



of this wetland. The vegetation community identified at Wetland 2 was comprised of greater than 50% wet adapted vegetation species based on their indicator status (i.e., FAC, FACW, OBL) (USACE 1987); therefore, this wetland is considered to have a "hydrophytic" or wet adapted vegetation community. The wetland also had wet soil indicators in the form of abundant iron concentrations in soil close to the surface as well as a gleyed (depleted) layer indicating that the water table regularly moves into this layer of the soil. The wetland had several hydrology indicators including, the presence of surface water, and a high water table. The origin of the wetland is expected to be natural due to its position on the landscape, within a natural depression caused by sinking of the gypsum bedrock.

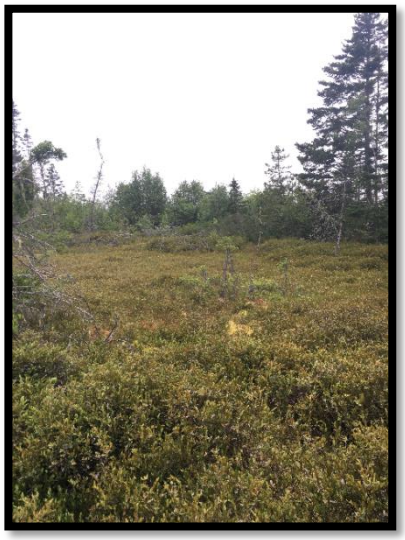
Wetland 3 (WL3) – 1.8 ha Unmapped Fen/Wet Meadow Complex



Based on the results of the field assessment, Wetland 3 is characterized as a permanently flooded/saturated throughflow fen/wet meadow complex associated with the floodplain of a lotic watercourse system. The area of the wetland delineated within the PDA totalled 1.8 ha; however, the wetland extends off-site, and is hydrologically connected to a mapped (regulated) wetland located just northeast of the PDA through a mapped watercourse (WC1; refer to **Section 5.4** for further details). Due to recent cut-over, there was no overstory (trees) within the wetland. The shrub layer was dominated by red osier dogwood (*Cornus sericea),* speckled alder (*Alnus incana*) and steeplebush. The herbaceous understory layer was dominated by common spikerush, woolgrass, common water parsnip (*Sium suave*), and marsh seedbox (*Ludwigia palustris*). The vegetation community identified at Wetland 3 is comprised of greater than 50% wet adapted vegetation species based on their indicator status (i.e., FAC, FACW, OBL) (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 the 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 in soil close to the surface as well as a gleyed (depleted) layer indicating that the water table regularly moves into this layer of the soil. The wetland had several hydrology indicators including, the presence of surface water, and a high water table. The origin of the wetland is expected to be natural due to its connection with a mapped watercourse and adjacent wetland.

As noted above, this unmapped wetland is connected to a mapped wetland and a mapped watercourse, therefore, it is considered to be a part of a larger wetland complex. The development of the open pit for extraction of gypsum will result in the direct loss of the unmapped portion of the wetland (i.e., WL3). Due to the location of the gypsum deposit (the thickest portion of the deposit is located in the northeastern portion of the property; refer to **Section 2.2 and 2.3** for further details), there are no other feasible alternatives to the placement of the open pit (refer to **Section 2.8** for further details on Alternative means of carrying out the project). Although it is known that WL3 will be directly lost as a result of the development of the open pit, the indirect effects of this Project activity on the mapped portion of the wetland complex (located outside of the PDA) is currently unknown (refer to **Section 5.5.3** for further details of anticipated residual effects).

Wetland 4 (WL4) – 0.3 ha Unmapped Bog



Based on the results of the field assessment, Wetland 4 is characterized as an isolated 0.3 ha seasonally flooded and permanently saturated bog. This wetland is connected to Wetlands 5 and 6 through a field identified wetland connection channel (refer to **Figure 5.5.1**). The treed overstory was dominated by black spruce (*Picea mariana*) and eastern larch (*Larix laricina*). The shrub layer was dominated by leatherleaf (*Chamaedaphne calyculata*); rhodora (*Rhododendron canadense*); sheep laurel (*Kalmia angustifolia*); and false holly (*Nemopanthus mucronatus*). The herbaceous understory layer was dominated by large cranberry (*Vaccinium macrocarpon*), tawny cottongrass (*Eriophorum virginicum*); and *Carex* sp. The vegetation community identified at Wetland 4 is comprised of greater than 50% wet adapted vegetation species based on their indicator status (i.e., FAC, FACW, OBL) (USACE 1987); therefore, this wetland is considered to have a "hydrophytic" or wet adapted vegetation community. The wetland also had wet soil indicators in the form of a thick layer (over 48 inches) of peat. The wetland had several hydrology indicators including, the presence of surface water, a high water table and saturation of soil as well as stunted and stressed vegetation. The origin of the wetland is expected to be natural due to the depth of peat within the wetland and its position within the landscape (i.e., basin).

Wetland 5 – 1.09 ha Unmapped Bog/Wet Meadow Complex

Based on the results of the field assessment, Wetland 5 is characterized as a 1.09 ha seasonally flooded and permanently saturated outflow bog/wet meadow complex located on a slope. This wetland is connected to Wetland 4 through a field identified wetland connection channel (refer to **Figure 5.5.1**). The treed overstory was dominated by red maple (*Acer rubrum*), black spruce, and eastern larch. The shrub layer was dominated by sheep laurel, trembling aspen (*Populus tremuloides*), leatherleaf, rhodora, false holly (*Nemopanthus mucronatus*), steeplebush, and white meadowsweet. The herbaceous



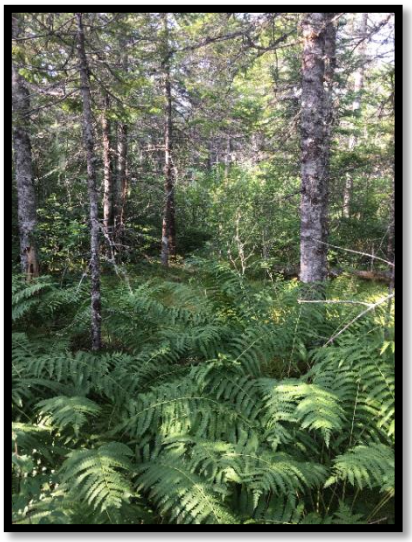
understory layer was dominated by woolgrass, spotted Joe-Pye weed (*Eupatorium maculatum*), and large cranberry. The vegetation community identified at Wetland 5 is comprised of greater than 50% wet adapted vegetation species based on their indicator status (i.e., FAC, FACW, OBL) (USACE 1987); therefore, this wetland is considered to have a "hydrophytic" or wet adapted vegetation community. There were no flora SAR or SOCC observed during the 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 that occur in this wetland on a seasonal basis. The wetland had several hydrology indicators including, a high water table and saturation of soil as well as stunted and stressed vegetation. The origin of the wetland is expected to be natural.

Wetland 6 – 0.07 ha Unmapped Bog



Based on the results of the field assessment, Wetland 6 is characterized as an isolated 0.07 ha seasonally flooded and permanently saturated bog located within a basin. This wetland is connected to Wetland 4 through a field identified wetland connection channel (refer to **Figure 5.5.1**). The treed overstory was dominated by red maple, black spruce, and white pine (*Pinus strobus*). The shrub layer was dominated by leatherleaf, white meadowsweet, and false holly. The herbaceous understory layer was dominated by woolgrass, two-seeded sedge (*Carex disperma*), cinnamon fern (*Osmunda cinnamomea*), tawny cottongrass, and crested shield fern (*Dryopteris cristata*). The vegetation community identified at Wetland 6 is comprised of greater than 50% wet adapted vegetation species based on their indicator status (i.e., FAC, FACW, OBL) (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 the desktop or field delineations of this wetland. The wetland also had wet soil indicators in the form of a thick organic layer (40 inches) over top of mineral soil that is slower to decompose due to wet conditions that occur in this wetland on a seasonal basis. The wetland had several hydrology indicators including, a high water table and saturation of soil as well as stunted and stressed vegetation. The origin of the wetland is expected to be natural.

Wetland 7 – 0.68 ha Unmapped Shrub Swamp



Based on the results of the field assessment, Wetland 7 is characterized as a 0.68 ha seasonally flooded and permanently saturated outflow shrub swamp. The treed overstory was dominated by balsam fir (*Abies balsamea*), red maple, and black spruce. The shrub layer was dominated by speckled alder, false holly, and wild raisin (*Viburnum nudum*). The herbaceous understory layer was dominated by cinnamon fern, interrupted fern (*Osmunda claytoniana*), slender manna-grass, two-seeded sedge, and dwarf enchanter's nightshade (*Circaea alpina*).The vegetation community identified at Wetland 7 is comprised of greater than 50% wet adapted vegetation species based on their indicator status (i.e., FAC, FACW, OBL) (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 the desktop or field delineations of this wetland. The wetland also had wet soil indicators in the form of a thick organic layer at surface that is slower to decompose due to wet conditions that occur in this wetland on a seasonal basis; as well as iron concentrations near surface indicating that the water table regularly moves into this layer of the soil. The wetland had several hydrology indicators including: the presence of surface water, a high water table, and saturation of soil, as well as water stained leaves. The origin of the wetland is expected to be natural.

Wetland 8 – 0.93 ha Unmapped Treed Swamp



Based on the results of the field assessment, Wetland 8 is characterized as a 0.93 ha seasonally flooded and permanently saturated outflow treed swamp located on a slope. This outflow swamp is connected to a mapped watercourse (WC3; refer to **Section 5.4** for further details). The treed overstory was dominated by northern white cedar (*Thuja occidentalis*), red maple, balsam fir, black spruce, and eastern larch. The shrub layer was dominated by speckled alder and false holly. The herbaceous understory layer was dominated by jewelweed (*Impatiens capensis*), cinnamon fern, interrupted fern, slender manna-grass, Canada manna-grass (*Glyceria canadensis*), sensitive fern (*Onoclea sensibilis*).The vegetation community identified at Wetland 8 is comprised of greater than 50% wet adapted vegetation species based on their indicator status (i.e., FAC, FACW, OBL) (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 the desktop or field delineations of this wetland. The wetland also had wet soil indicators in the form of a thick organic layer

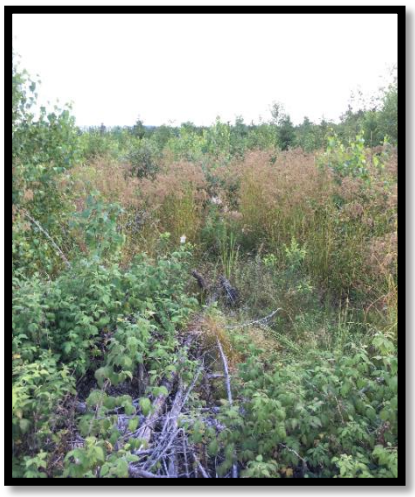
at surface that is slower to decompose due to wet conditions that occur in this wetland on a seasonal basis. The wetland had several hydrology indicators including: the presence of surface water, a high water table, and saturation of soil, as well as water stained leaves. The origin of the wetland is expected to be natural.

Wetland 9 – 0.19 ha Unmapped Treed Swamp



Based on the results of the field assessment, Wetland 9 is characterized as a seasonally flooded and permanently saturated outflow treed swamp located on a slope. This outflow wetland is connected to a mapped watercourse (WC2; refer to **Section 5.4** for further details). During the field assessment, 0.19 ha of the wetland was delineated within the PDA, however, the wetland extends off of the property (this area was not delineated). The treed overstory was dominated by northern white cedar, red maple, and balsam fir. The shrub layer was dominated by speckled alder and red maple. The herbaceous understory layer was dominated by cinnamon fern, bluejoint reed grass (*Calamagrostis Canadensis)*, interrupted fern, slender manna-grass, Canada manna-grass (*Glyceria canadensis*), prickly sedge (*Carex echinata*). The vegetation community identified at Wetland 9 is comprised of greater than 50% wet adapted vegetation species based on their indicator status (i.e., FAC, FACW, OBL) (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 the desktop or field delineations of this wetland. The wetland also had wet soil indicators in the form of a thick organic layer at surface that is slower to decompose due to wet conditions that occur in this wetland on a seasonal basis; as well as a gleyed (depleted) layer indicating that the water table regularly moves into this layer of the soil. The wetland had several hydrology indicators including: the presence of surface water, a high water table, and saturation of soil, as well as water stained leaves. The origin of the wetland is expected to be natural.

Wetland 10 – 0.10 ha Unmapped Shrub Swamp



Based on the results of the field assessment, Wetland 10 is characterized as a 0.10 ha seasonally flooded and permanently saturated outflow shrub swamp located on a slope. Due to recent cut-over, there is no overstory (trees) within the wetland. The shrub layer was dominated by false holly, sheep laurel, steeplebush, and red maple. The herbaceous understory layer was dominated by woolgrass, soft rush (*Juncus effusus*). The vegetation community identified at Wetland 10 is comprised of greater than 50% wet adapted vegetation species based on their indicator status (i.e., FAC, FACW, OBL) (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 the desktop or field delineations of this wetland. The wetland also had wet soil indicators in the form of a thick organic layer at surface that is slower to decompose due to wet conditions that occur in this wetland on a seasonal basis as well as stratified layers. The wetland had several hydrology indicators including: a high water table, and saturation of soil, as well as water stained leaves. The origin of the wetland is unknown and may be the result of tree removal and soil compaction from former logging activities.

Wetland 11 – 0.31 ha Unmapped Shrub Swamp/Wet Meadow

Based on the results of the field assessment, Wetland 11 is characterized as a 0.31 ha seasonally flooded and permanently saturated outflow shrub swamp located on a slope. This outflow wetland is connected to a field identified watercourse (WC4; refer to **Section 5.4** for further details). Due to recent cut-over, there is no overstory (trees) within the wetland. The shrub layer was dominated by white meadowsweet, speckled alder, willow spp. (*Salix* spp.) and bristly black currant (*Ribes lacustre*). The herbaceous understory layer was dominated by woolgrass, soft rush (*Juncus effuses)* spotted Joe-Pye weed, and marsh willow-herb (*Epilobium palustre*). The vegetation community identified at Wetland 11 is comprised of greater than 50% wet adapted vegetation species based on their indicator status (i.e., FAC, FACW, OBL) (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 the desktop or field delineations of this wetland. A single *Spiranthes* spp. specimen was encountered along the edge of Wetland 11. The specimen had begun to go to seed when encountered and was not able to be identified to species at the time of the field assessment, but its habitat and location were consistent with *Spiranthes lucida,* an SOCC listed as an "Uncommon" (S3) species



identified by the AC CDC. The wetland also had wet soil indicators in the form of a thick organic layer at surface that is slower to decompose due to wet conditions that occur in this wetland on a seasonal basis as well as stratified layers. The wetland had several hydrology indicators including: a high water table, and saturation of soil. The origin of the wetland is unknown and may be the result of tree removal and soil compaction from former logging activities.

Wetland 12 – Unmapped 0.08 ha Shrub Swamp



Based on the results of the field assessment, Wetland 12 is characterized as a seasonally flooded and permanently saturated throughflow shrub swamp located along a lentic stream system. During the field assessment, 0.08 ha of the wetland were delineated; however, the wetland extends off of the property (this area was not delineated to avoid trespassing on private property). Due to recent cut-over, there is no overstory (trees) within the wetland. The shrub layer was dominated by speckled alder, false holly, wild raisin, and white meadowsweet. The herbaceous understory layer was dominated by slender manna-grass, small floating manna-grass (*Glyceria borealis*), sensitive fern, arrow-leaved tearthumb (*Polygonum sagittatum*). The vegetation community identified at Wetland 12 is comprised of greater than 50% wet adapted vegetation species based on their indicator status (i.e., FAC, FACW, OBL) (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 the desktop or field delineations of this wetland. The wetland also had wet soil indicators in the form of a thick organic layer at surface that is slower to decompose due to wet conditions that occur in this wetland on a seasonal basis as well as a gleyed (depleted) layer indicating that the water table regularly moves into this shallow layer of soil. The wetland had several hydrology indicators including: the presence of surface water, a high water table, saturation of soil, and aquatic fauna. The origin of the wetland is considered to be natural.

Wetland 13 – 0.27 ha Unmapped Wet Meadow



Based on the results of the field assessment, Wetland 13 is characterized as a 0.27 ha seasonally flooded and permanently saturated outflow wet meadow located on a slope. Due to recent cut-over, there is no overstory (trees) within the wetland. The shrub layer was dominated by white meadowsweet, steeplebush, speckled alder, and red raspberry (*Rubus idaeus*). The herbaceous understory layer was dominated by woolgrass, narrow-leaved cattail, sensitive fern, nodding sedge (*Carex gynandra*), and narrow-leaved tearthumb. The vegetation community identified at Wetland 13 is comprised of greater than 50% wet adapted vegetation species based on their indicator status (i.e., FAC, FACW, OBL) (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 the desktop or field delineations of this wetland. The wetland also had wet soil indicators in the form of a thick organic layer at surface that is slower to decompose due to wet conditions that occur in this wetland on a seasonal basis as well as stratified layers. The wetland had several hydrology indicators including: the presence of surface water, a high water table, saturation of soil, and aquatic fauna. The origin of the wetland is unknown and may be the result of tree removal and soil compaction from former logging activities.

During the field assessment, anthropogenic activities/effects were noted throughout the assessed wetlands. The activities included soil compaction and rutting due to former logging road development and former tree harvesting within or directly adjacent to all wetlands.

For the detailed results of the WESP-AC functional assessments conducted for the Wetlands 1-13, refer to the WESP-AC sheets provided in **Appendix B**.

Wetland and Upland Vegetation Communities

In addition to the characterization of wetland vegetation communities during the wetland delineations, upland vascular vegetation communities were inventoried in the field by a Dillon biologist skilled in the identification of common and rare plant species of New Brunswick. The vascular plant inventory for the PDA was completed during the site visits between August 14 and 16, 2018. 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 plant species lists provided in **Appendix C**.

Approximately 65% (40 hectares) of the PDA was cut-over for logging purposes beginning in the late summer of 2010. The remaining forest cover is mostly associated with wetland areas and stream buffers to the southern end of the PDA, as well as some limited tree "islands" in the centre of the PDA that are associated with sinkholes. The forested areas immediately surrounding the site are composed primarily

of middle-age softwood dominated forest comprised of balsam fir, red spruce (*Picea rubens*), northern white cedar, white spruce (*Picea glauca*), white birch (*Betula papyrifera*), and red maple.

Although there were no vegetation SAR or SOCC identified during the AC CDC records review, a single *Spiranthes* spp. specimen was encountered along the edge of Wetland 11. The specimen had begun to go to seed when encountered and was not able to be identified to species at the time of the field assessment, but its habitat and location were consistent with *Spiranthes lucida,* listed as an "Uncommon" (S3) species identified by the AC CDC. There were no other SOCC or SAR species identified during these surveys. Refer to detailed plant species lists provided in **Appendix C**.

5.5.3 Environmental Effects Assessment

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

5.5.3.1 Potential Effects

The Project is expected to interact with wetlands and vegetation throughout all phases (i.e., construction, operation, reclamation and closure). The primary possible effects to wetlands include direct loss of wetland area or function for those wetlands in the PDA that will be subjected to Project activities such as site clearing, grubbing, and construction of infrastructure, access roads and blasting /extraction of gypsum. Additionally, 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 the 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 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 4.78 ha of unmapped (field identified) wetlands within the PDA, but no regulated (mapped) wetlands are located in the PDA nor is it expected that they will be directly affected by the Project.
- The construction and operation phases of the Project may result in the indirect loss of wetland area or function associated with a regulated (mapped) wetland on a neighbouring property within the LAA (on the northeast corner of the PDA), which is connected to WL3 and WC1.
- 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 wetland restoration within the PDA).

5.5.3.2 Mitigation

Mitigation is identified for each interaction and/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 be conducted as mitigative measures prior to or during the interaction. The following mitigation will be implemented as a 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 insist in the management of surface water on-site;
- Efforts will be made to maintain as much mature vegetation along the edges of the site; in particular, existing treed buffers surrounding wetlands located on the southeastern and southwestern portions of the PDA will be maintained to the extent possible;
- Potential installation and/or upgrades to watercourse crossings (culverts) draining to wetlands will be designed as per the New Brunswick Watercourse and Wetland Alteration (WAWA) Guidelines (NBDELG 2012);
- Obtaining a watercourse and wetland alteration (WAWA) permit for any alterations to regulated wetlands (and their 30 m buffers) that result in a net loss of wetland function as a result of the Project, with applicable compensation, under the New Brunswick *Clean Water Act* and New Brunswick Wetlands Conservation Policy (NBDNRE-NBDELG 2002);
- Construction and operation activities will comply with the conditions of the WAWA permit;
- Proper erosion and sediment control measures will be installed and checked regularly and prior to and after storm events to ensure they are continuing to operate properly to minimize potential effects to adjacent habitat;
- All construction equipment will be properly cleaned prior to mobilizing to site to avoid potential introduction of invasive species;
- 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;
- 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; and,
- A follow-up vegetation survey will be conducted in the Spring of 2019 to confirm *Spiranthes* species for proper identification of the potential SOCC *Spiranthes lucida*.

5.5.3.3 Characterization of Residual Effects

Though much of the Project site has been cleared already for logging purposes, the Project will result in the loss of immature vegetation within the PDA so that Project facilities can be developed. There are no known occurrences of plant SAR or SOCC on the Project site, with the possible exception of *Spiranthes* species which will be confirmed through a follow-up field survey in Spring 2019. Remaining mature vegetation located along the property boundaries as well as surrounding wetlands and watercourses located on the southeast portion of the PDA will be maintained to the extent possible. Forest habitat is ample in the LAA and beyond, and the loss of immature vegetation will not result in a change in species distribution or threats to the population on a landscape level. Thus, the Project is not expected to result in a substantive interaction with vegetation during any phase.

The Project will result in the direct loss of approximately 4.78 ha of unmapped wetland within the PDA, to allow for the construction of the open pit and related surface facilities to be located on site. 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 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 on some 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 on the Project site and not subject to direct disturbance as a result of the Project activities, a regulated (mapped) wetland that is contiguous to WL3 (to the northeast of the Project site) will likely experience indirect effects as a result of water infiltration into the open pit. Establishing a substantial buffer around this regulated wetland in an effort to minimize a change in wetland function of this wetland would render the Project unfeasible. This indirect loss cannot be characterized at this early planning stage and ongoing follow-up and monitoring (with adaptive management as necessary) will be conducted to monitor any changes that may occur to this wetland and to plan response actions. However, a change in wetland function of this wetland is likely unavoidable if the Project is to proceed. Any regulated wetlands that are located on adjacent properties to the Project site and which may experience indirect net loss of wetland function due to potential localized changes in surface water hydrology due to the presence of the Project (e.g., draining into the open pit) will be monitored through the Project life 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 'compensation' will be considered for all potential impacts to wetlands within the PDA and LAA. Applicable authorization (i.e., WAWA permit and associated compensation) will be secured with NBDELG prior to undertaking construction activities within 30 m that could affect regulated wetlands, will reduce the potential net loss of wetland function. Follow-up and 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.

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 vegetative invasive species to the area.

The direct/indirect net loss of wetland function in regulated (mapped) wetlands that is deemed by NBDELG and Environment and Climate Change Canada (ECCC) to result in a 'no net loss of wetland function" under the New Brunswick Wetlands Conservation Policy (NBDNRE-NBDELG 2002) requires wetland compensation for net loss of wetland function of a regulated wetland at a 2:1 ratio. All enterprises, activities, projects, works, or programs affecting two or more hectares of bog, marsh or other wetland must be submitted to the NBDELG for review in accordance with the EIA pursuant the *Clean Environment Act*.

5.5.4 Summary

Based on the above, with planned mitigation, authorization (with compensation), and environmental protection measures, the residual environmental effects of the Project on vegetation and wetlands during all phases of the Project are rated 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 herpetiles 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, herpetile, and other species at risk. Most bird species, specifically, are protected under the *Migratory Birds Convention Act*. The wildlife and wildlife habitat VC has connections to the vegetation and wetlands VC (**Section 5.5**) because of its relationship with vegetation, hydrology, land form, and soil components.

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 Energy and Resource Development (NBDERD).

As part of the desktop assessment, a site-specific AC CDC report (AC CDC 2018) was obtained for the Project area (refer to **Appendix A**). The report provided historical flora and fauna species occurrence, as well as environmentally sensitive or managed areas within 5 km of the Project site. Wildlife species at risk or species of conservation concern are identified as extremely rare (S1), rare (S2), or uncommon (S3).

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 six months, anticipated to begin in the second quarter of 2019 (subject to the receipt of all approvals and permits required for the Project);
- Operation: beginning in approximately the fourth quarter of 2019, 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) 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 61.81 ha (i.e., conservatively assumed to be the entirety of PID No. 00149013) 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 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 limited field-level reconnaissance surveys. Additional confirmatory biophysical field studies for avian wildlife will be completed during appropriate seasonal timing windows in Spring and Summer 2019, targeting potential at risk wildlife species and their critical habitat as identified in the desktop assessment.

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, double-crested cormorant, and European starling) 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 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 #12, Saint John, at the southernmost extent of Square #20KR94 (Salt Springs), with the two nearest roadside breeding bird point counts within 1 km of the Project area, to both the east and the west of the PDA (BSC 2018; see **Appendix D**, **Table D.1**). During the MBBA period 2006-2010, a total of 96 species of birds were recorded within this square. Of these species, 64 were confirmed as breeding, 19 were probable breeders, and 13 were possible breeders. There were seven species at risk or species of conservation concern detected during the most recent MBBA in this square. These species included: bald eagle, bank swallow, barn swallow, bobolink, Canada warbler, common nighthawk, and olive-sided flycatcher (BSC 2018).

NBDERD's *General Status of Wild Species* (NBDERD 2018a) reports that there are 407 extant bird species known to occur in the New Brunswick, of which 143 are considered accidental (NBDERD 2018a). Of the species that regularly occur in the Province during at least part 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 nearest Important Bird Area (IBA) is Quaco Bay, located along the northern coast of the Bay of Fundy, which is approximately 17 km from the Project area to the southeast. Featuring intertidal reef ledges, bordered by mud flats and a few shallow inlets, this IBA is especially important for semipalmated

plovers and least sandpipers during fall migration (Nature NB 2018). Preferred habitat for these two species is not present within the LAA.

AC CDC Species at Risk Database Review

A review of the AC CDC database indicated that there were 45 records of 24 vertebrate species historically observed within 5 km of the PDA; 16 records are considered species at risk (SAR) or species of conservation concern (SOCC), including one "location sensitive" species (i.e., bald eagle) which intersects the Project area (AC CDC 2018).

Of the 24 species at risk/species of conservation concern identified by the AC CDC, nine are listed as "Threatened" pursuant the federal *Species at Risk Act*, while seven of those species are also listed as "Threatened" pursuant New Brunswick's *Species at Risk Act*. In addition to the SAR species list above, two species listed as "Special Concern" pursuant to the federal *Species at Risk Act* and New Brunswick's *Species at Risk Act*. 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 Project area, is discussed in **Table 5.6.1**, below.

Table 5.6.1: Bird Species At Risk Historically Observed within 5 km of the Project (AC CDC 2018)

Species	Status*	Habitat	Potential to Occur in Project Area
Bald Eagle (*Haliaeetus leucocephalus*)	**COSEWIC:** Threatened **SARA:** Threatened **NB SARA**: Threatened	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 Hammond River and the presence of forested areas within the PDA, it is possible that this species may use the Project area for foraging purposes or occur within the PDA incidentally. The PDA does not offer preferential habitat for this species.
Bank Swallow (*Riparia riparia*)	**COSEWIC:** Threatened **SARA:** Threatened **NB S Rank:** S2S3B,S2S3M/3	Typically nest in steep embankments along eroding river/ocean shore and forage in open areas (COSEWIC 2013).	There are no large open habitats directly within the LAA. The Hammond River and other nearby tributaries may offer an eroding river bank which may provide potential nesting habitat. There is potential for this species to occur in the PDA incidentally or use the area for foraging purposes;

Table 5.6.1: Bird Species At Risk Historically Observed within 5 km of the Project (AC CDC 2018)

Species	Status*	Habitat	Potential to Occur in Project Area
			however, the PDA does not offer preferential habitat for this species.
Barn Swallow (*Hirundo rustica*)	**COSEWIC:** Threatened **SARA:** Threatened **NB SARA**: Threatened **NB S Rank:** S2B,S2M/ 3 Sensitive	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.
Bobolink (*Dolichonyx oryzivorus*)	**COSEWIC:** Threatened **SARA:** Threatened **NB SARA**: Threatened **NB S Rank:** S3B,S3M/ 3 Sensitive	Typically nest in lush meadows, open grasslands, and hayfields (COSEWIC 2010).	The PDA consists predominantly of young deciduous regrowth, and some mixed mature forest to the east and west. There are no large open agricultural fields, preferred by bobolink directly within the LAA, although there are open fields located within 5 km. The PDA does not provide preferential habitat for this species and it is unlikely that this species would use habitat within the PDA.
Canada Warbler (*Wilsonia canadensis*)	**COSEWIC:** Threatened **SARA:** Threatened **NB SARA**: Threatened **NB S Rank:** S3B, S3M/ 1 At Risk	Typically breeds throughout Maritimes and southeastern Canada. Typical habitat includes a variety of forest types (COSEWIC 2008). They prefer wet mixed forest with well-developed shrub layer as well as regenerating areas.	The Project area is dominated by young deciduous regrowth, consistent with Canada warbler preferential habitat. A Canada warbler was observed foraging (incidentally) in a wetland (WL7) in the northwestern portion of the PDA during biological field studies in summer 2018, and has the potential to occur in areas within the LAA.

Table 5.6.1: Bird Species At Risk Historically Observed within 5 km of the Project (AC CDC 2018)

Species	Status*	Habitat	Potential to Occur in Project Area
Chimney Swift (*Chaetura pelagica*)	**COSEWIC:** Threatened **SARA:** Threatened **NB SARA**: Threatened **NB S Rank:** S2S3B,S2M	Historically, the Chimney Swift used mainly large hallow trees for nesting sites but have adopted chimneys as preferred nesting sites. They are generally associated with urban and rural areas where chimneys are available for nesting and roosting. Chimney swifts are aerial foragers and tend to concentrate near water where insects are abundant (COSEWIC 2007a).	Although there are unlikely any large hollow trees suitable for this species within the PDA, there may be hollow trees or chimneys for nesting and roosting within the LAA. The watercourses within the PDA could provide marginal foraging habitat although it is expected that the nearby Hammond River would be selected as a preferred area for foraging.
Common Nighthawk (*Chordeiles minor*)	**COSEWIC:** Threatened **SARA:** Threatened **NB SARA**: Threatened **NB S Rank:** S3B,S4M/1 At Risk	Common nighthawk typically breeds throughout the Maritimes and nests on the ground in open vegetation free habitats (COSEWIC 2007b).	The PDA is dominated by young deciduous regrowth. There are few vegetation free habitats directly within the PDA, however, there are open wetlands located in the northeastern portion of the PDA. The species was observed (incidentally) foraging during biological field studies in summer 2018, and has the potential to occur in areas within the LAA.
Eastern Wood-Pewee (*Contopus virens*)	**COSEWIC:** Special Concern **SARA:** Special Concern **NB SARA**: Special Concern **NB S Rank:** S4B,S4M	The Eastern Wood-pewee is often associated with the mid-canopy layer of forest clearings and edges of deciduous and mixed forests. It is 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	The majority of the PDA is comprised of early successional regeneration or recent cut-over; therefore, it is unlikely that the Eastern wood-peewee would use the PDA for foraging or breeding purposes. However, they may use the area as a stopover during migration. There is potential for this

Table 5.6.1: Bird Species At Risk Historically Observed within 5 km of the Project (AC CDC 2018)

Species	Status*	Habitat	Potential to Occur in Project Area
		successional clearings (COSEWIC 2012a).	species to occur in areas of intermediate/mature stands within the LAA.
Olive-sided Flycatcher *(Contopus cooperi)*	**COSEWIC:** Threatened **SARA:** Threatened **NB SARA**: Threatened **NB S Rank:** S3B,S3M/1 At Risk	Typically breeds in coniferous edges and open areas with perches (e.g., forest openings near wetlands and clear-cuts) (COSEWIC 2007c)	The PDA consists of young deciduous regrowth, surrounded by mature coniferous dominant habitat with available wetland habitats. There is preferential habitat for this species immediately adjacent to the PDA and it is possible that this species may use areas within the LAA for foraging purposes.
Rusty Blackbird (*Euphagus carolinus*)	**COSEWIC:** Special Concern **SARA:** Special Concern **NB SARA**: Special Concern N**B S Rank:** S3B,S3M	Typically breeds in coniferous-dominated forests adjacent to wetlands, such as slow-moving streams, peat bogs, sedge meadows, marshes, swamps and beaver ponds (COSEWIC 2017).	The PDA may contain habitat suitable for breeding in the wetland area located at near the boundary of the PDA although these areas are not considered preferential habitat for this species.
Wood Thrush (*Hylocichla mustelina*)	**COSEWIC:** Threatened **SARA:** Threatened **NB SARA**: Threatened **NB S Rank:** S1S2B,S1S2M	Wood Thrush nests mainly in second-growth and mature deciduous and mixed forests, with saplings and well-developed understory layers. Large forest mosaics are preferred, but they may also nest in small forest fragments (COSEWIC 2012b).	The PDA consists predominantly of young deciduous regrowth, and some mixed mature forest to the east and west. The PDA does not provide preferential habitat for this species and it is unlikely that this species would use habitat within the PDA.

Notes: 1 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 2018)

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 mid-April to late August each year (ECCC 2018b). However, it is noted that some avian species nest outside of this period, including corvids, crossbills, owls and waxwings.

Bird surveys were not conducted as a part of this assessment due to timing; breeding bird surveys will be conducted during the appropriate breeding bird window in Spring 2019, and the results will be presented within a supplementary report. However, during the August 2018 field surveys, Canada warbler and common nighthawk were incidentally observed in flight over the PDA at the locations provided on **Figure 5.6.1**.

5.6.2.2 Mammals

NBDERD's *General Status of Wild Species* (NBDERD 2018a) 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 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", 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*) under the federal SARA.

A review of the AC CDC database (AC CDC 2018) indicated that there are no records of federally or provincially protected mammals, and that no hibernaculum has been reported to be within 5 km of the PDA.

Incidental observations of wildlife signs recorded during 2018 field surveys included: Eastern coyote (*Canis latrans*) scat; moose (*Alces alces*), White-tailed deer (*Odocoileus virginianus), and* snowshoe hare (*Lepus americanus*) pellets. A racoon skull was observed during the vegetation and wetlands survey on August 14, 2018. Two white-tailed deer were observed in the PDA during the noise monitoring field program on September 25, 2018. White-tailed deer use a wide variety of habitats throughout most of the year but depend on deer wintering areas during the winter months (GNB 2018a). The PDA does not provide suitable deer wintering habitat due to the limited amount of canopy cover throughout most of the property.

A review of GIS layers containing locations of known and potential bat hibernacula (i.e., abandoned mines and caves) in southern New Brunswick indicates that the potential for hibernacula exists within 5 km of the Project site. Observations made during the 2018 field surveys confirm that there are no caves or abandoned mine openings within the PDA, and no bats were incidentally observed.

5.6.2.3 Invertebrates

Lists of butterfly and odonate (dragonfly and damselfly) species in New Brunswick is maintained in the NBDERD's *General Status of Wild Species* database (NBDERD 2018a). The database currently lists 80 butterfly and 131 odonate species known to occur in the province. Of these species, one (Maritime

ringlet) is considered to be "At Risk", 15 (4 butterflies and 11 odonates) are considered "May be At Risk", and 13 (one butterfly and 12 odonates) are considered "Sensitive". The cobblestone tiger beetle (*Cicindela marginipennis*), Maritime ringlet (a butterfly), and skillet clubtail (an odonate) are listed as "Endangered" under SARA, while the monarch butterfly and pygmy snaketail (an odonate) are considered to be SOCC. The Maritime ringlet is listed as "Endangered" under the NB SARA.

A review of the AC CDC database (AC CDC 2018) indicated that there are no records of federally or provincially protected invertebrates within 5 km of the Project area.

Autumn meadowhawks (*Sympetrum vicinum*) were incidentally observed in the PDA during the wetland and vegetation surveys completed on August 14 – 16, 2018.

5.6.2.4 Herpetiles

NBDERD's *General Status of Wild Species* database (NBDERD 2018a) reports that there are 7 reptile and 16 amphibian species known to occur in New Brunswick. Of these species, one (wood turtle) is considered to be "At Risk" and one (dusky salamander) is considered "Sensitive". No terrestrial reptiles or amphibians are listed under the NB SARA. Under the federal SARA, the wood turtle is listed as "Threatened", and the snapping turtle is considered a SOCC.

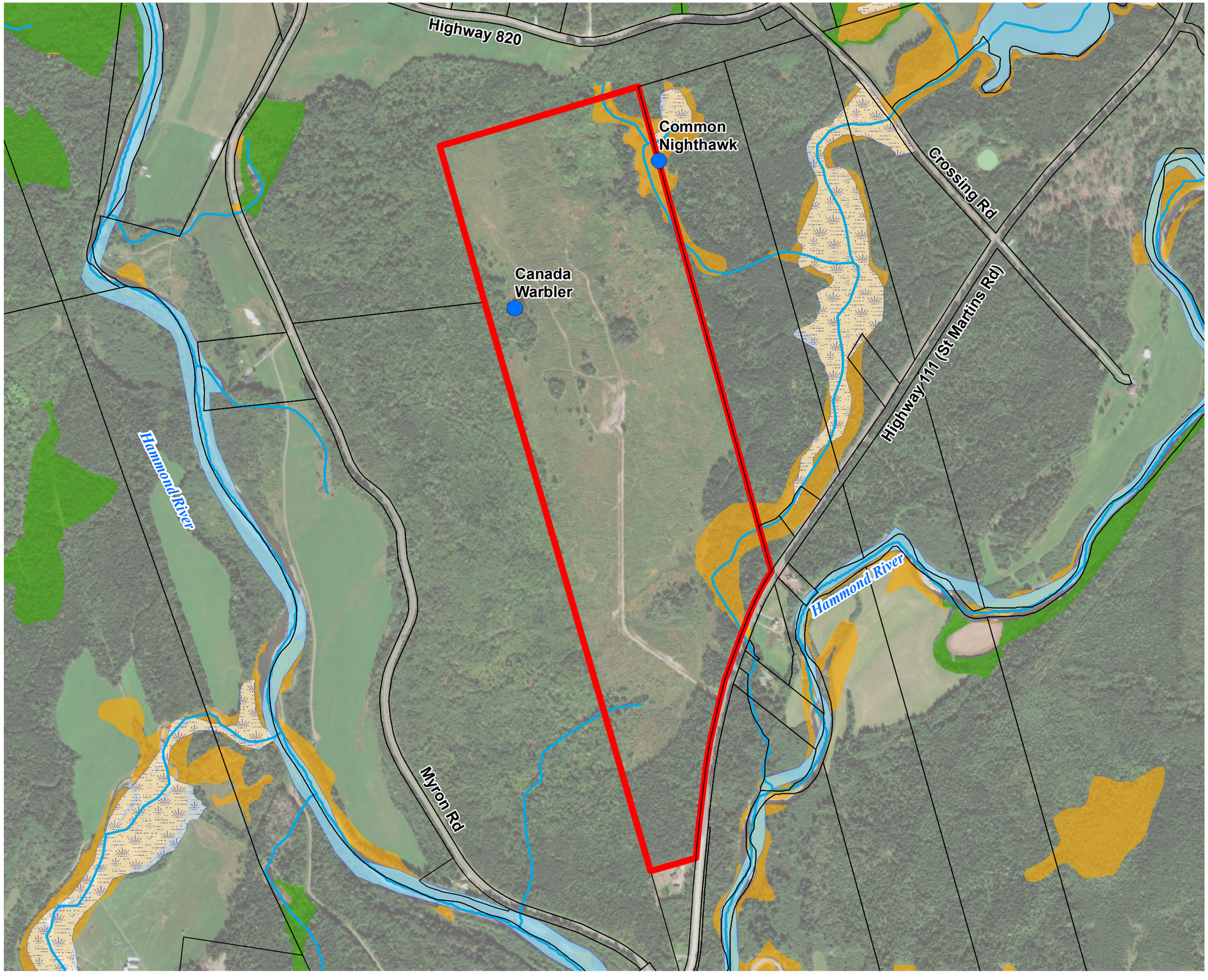
Snapping turtles generally inhabit ponds, sloughs, streams, rivers, and shallow bays that are characterized by slow moving water, aquatic vegetation, and soft, muddy bottoms. Wood turtles are generally associated with watercourses and the riparian habitats associated with them. Individuals nest on sandy and gravelly riverbanks but will also make use of other features such as sand pits and road embankments near watercourses that provide a sandy or gravelly substrate. Both snapping turtles and wood turtles are known to overwinter in deep pools in larger rivers and in deep ponds. The Hammond River provides the nearest turtle overwintering habitat to the Project Area. It is possible that individuals of each species could wander upstream on tributaries from the Hammond River to foraging areas at or near the PDA during the summer season.

A review of the AC CDC database (AC CDC 2018) indicated that there are no records of federally or provincially protected terrestrial reptiles or amphibians within 5 km of the Project area. No turtle species or evidence of turtle presence was observed during 2018 field studies.

Wood frog (*Rana sylvatica)* and eastern red-backed salamander (*Plethodon cinereus*) were incidentally observed within the PDA during the fish and fish habitat field surveys completed on August 29 – 30, 2018.

5.6.2.5 Environmentally Sensitive Areas

The site-specific AC CDC report (AC CDC 2018) 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.



HAMMOND RIVER HOLDINGS LTD.
PROPOSED UPHAM EAST GYPSUM QUARRY

INCIDENTAL WILDLIFE OBSERVATIONS
FIGURE 5.6.1

- SAR BIRD OBSERVED (AUG 2018)
- PROPERTY BOUNDARY
- PROJECT DEVELOPMENT AREA
- GEO NB MAPPED WATERCOURSE
- REGULATED WETLANDS

NBDELG DRAFT BETA WETLAND MAPPING (UNREGULATED)

- PROVINCIALLY SIGNIFICANT WETLANDS
- INTERMEDIATE WETLANDS
- FORESTED WETLANDS

0 50 100 200 m

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: BQS
MAP REVISED BY: JH
MAP CHECKED BY: AS
MAP PROJECTION: NAD_1983_CSRS_New_Brunswick_Stereographic

FILE LOCATION: \\DILLON.CA\DILLON_DFS\FREDERICTON\FREDERICTON CAD\CAD\GIS\188346 UPHAM GYPSUM QUARRY\MXD

DILLON CONSULTING

PROJECT: 18-8346
STATUS: FINAL
DATE: OCT 2018

According to the AC CDC records review and desktop analysis conducted to support this EIA Registration document, there are no biologically significant areas within 5 km of the Project footprint. The closest managed area is the Hanford and Porters Brook Sandstone Beds ESA, located approximately 1 km to the southwest of the Project area (AC CDC 2018). There are also no provincially identified deer wintering areas.

The PDA does not provide identified unique or limited habitat and is not located within a defined Environmental Sensitive Area 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 Project area were compared to the range of environmental conditions within the Project area 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, and the habitat is identified as a target for 2019 confirmatory field surveys.

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 ensure effective mitigation during construction phases 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 comprised 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

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);
- The Project footprint 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.

Herpetiles

The Project may interact with herpetiles 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 herpetiles 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 Hammond 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 effects 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 1 to August 31) to ensure 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;
- 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 Project area, 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 Project area, 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 species at risk is encountered, contact will be made to a Species at Risk Biologist at NBDERD at (506) 453-5873 or by email.

Mammals

- Because of past forestry activities throughout the Project area, it is unlikely that species particularly sensitive to human activities currently reside in the immediate Project area.

Herpetiles

- The most suitable habitat along tributaries upstream of the Hammond River for foraging turtle species is located approximately 300 m east of the PDA. This area will be preserved and a mature coniferous dominant upland forested area is between the tributary and its riparian area and the Project footprint.

5.6.3.3 Characterization of Residual Effects

Development of the Project will result in vegetation clearing and the loss of some immature and mature vegetation in the immediate Project area. 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 my 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.

AC CDC records indicate that no mammal or herpetile species at risk (SAR) have been historically observed within 5 km of the Project location, and no mammal or herpetile SAR were identified by Dillon biologists during the field surveys conducted for the Project. However, two bird SAR, common nighthawk and Canada warbler, were observed incidentally while in-flight over the PDA. Therefore, a direct interaction of SAR with the Project is not anticipated. 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 in the PDA may provide habitat for bird species, including SAR (e.g., common nighthawk, Canada warbler, and olive-sided flycatcher), 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 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 Environment and Climate Change Canada recommended timing window for the Project location to facilitate compliance with the MBCA, and a worker education program for identifying species at risk and species of conservation concern, the residual environmental effects of the Project on wildlife and wildlife habitat during all phases of the Project are rated not significant, with a

moderate level of confidence. Confirmatory avian surveys to be conducted in Spring and Summer 2019 to confirm the results of the desktop evaluation (in a separate supplemental report) will increase the level of confidence of this prediction.

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, with the exception of the confirmatory avian surveys mentioned previously.

5.7 Socioeconomic Environment

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

5.7.1 Scope of VC

The Project has the potential to interact with the socioeconomic environment, which includes land and resource use, and employment and the local economy. These potential interactions are of concern to regulatory agencies, non-governmental organizations, 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.

5.7.1.1 Temporal Boundaries

The temporal boundaries for the Project include the following:

- Construction: extending for a period of approximately six months, anticipated to begin in the second quarter of 2019 (subject to the receipt of all approvals and permits required for the Project);
- Operation: beginning in approximately the fourth quarter of 2019, 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 61.81 ha (i.e., conservatively assumed to be the entirety of PID No. 00149013) 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 Upham, Hanford Brook, and Upperton. The LAA includes the PDA and any adjacent areas along the preferred transportation route where Project-related environmental effects could be expected to occur.

5.7.1.3 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.

5.7.2 Existing Conditions

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

5.7.2.1 Land and Resource Use

The Project is located in the small community of Upham, Upham Parish, Kings County, in Southern New Brunswick (**Figure 1.1.1**). Like other communities in the LAA, Upham 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, solid waste management, and sports and

recreation services. Each commission is made up of representatives from the area's incorporated municipalities and incorporated Local Service Districts (LSDs).

The PDA is located within the RSC 8, which is comprised of 14 LSDs, the Villages of Norton and Sussex Corner, and the Towns of Sussex and Hampton. Refer to **Figure 5.7.1** for an illustration of the boundaries of RSC 8. The Project site is located within the LSD of Upham.

Land Use Planning

Development in Upham Parish is not guided by a Rural Plan or Basic Planning Statement; however, development projects are subject to provincial regulations and permitting and inspections is managed by RSC 8. Existing land uses in the LAA are shown in **Figure 5.7.2**.

Residential Land Use

Residential land use in the vicinity of the PDA is a linear pattern along the main roads, primarily Route 820 and Route 111. A point file of dwellings was created based on aerial imagery, and approximately 20 residential dwellings are located within a 1 km radius of the PDA. Statistics Canada's 2016 Census for Upham Parish indicates that the number of dwellings occupied by usual residents is 521, while the total number of private dwellings is 579 (Statistics Canada 2017).

Commercial Land Use

There is one small home-occupation business listed in the Yellow Pages and commercial websites that specializes in spa sales located near the PDA, on Route 820. It would appear that this commerce is limited to a home office and not a larger place of business.

Institutional Land Use

The Upham Volunteer Firefighter Hall is located at 2268 Route 820 in Upham, approximately 4 km from the PDA. Other institutional land uses within the general vicinity are limited to local churches and community halls.

Though they have no facilities located in the LAA, policing services are provided by the Royal Canadian Mounted Police (RCMP), with the nearest detachments located in Hampton 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, with the nearest hospitals located in Saint John.

Industrial Land and Resource Use

Industrial land uses in the general vicinity of the PDA are limited to small scale pit and quarry operations. The former Cassidy Lake potash mine was located approximately 12 km northeast of the PDA at Clover Hill, but was decommissioned in 1997; however, some limited buildings remain, and the tailings pond remains active.

Agricultural Land Use

Agricultural uses in the general vicinity of the PDA are primarily pasture and hay fields and occasional livestock farms.

Forestry Land and Resource Use

Forestry is an important industry in New Brunswick and occurs to varying degrees throughout the rural regions in the southwest of the province. The PDA itself has been the subject of forest harvesting in the past 10 years, and active woodlots are clearly evident on nearby properties.

Recreational Land and Resource Use

While there is no recreation-related infrastructure within the general vicinity of the PDA, the Hammond River is a primary water feature and recreational asset in the parish and in proximity of the PDA. The river is a recreational resource for angling and is located within Recreational Fishing Area (RFA) 6—Lower Saint John. Sportfish species found in waters in RFA 6 include brook trout, landlocked salmon, and smallmouth bass (NBDERD 2018b). The PDA is situated in wildlife management zone 23 and hunting, trapping and snaring are permitted in the area, with the exception of any Protected Natural Areas (NBDERD 2017). A number of all-terrain vehicle and snowmobile trails are likely also present in the LAA.

Transportation Land Use

Route 111 is the primary transportation route through Upham Parish. Route 111 runs between Sussex and St. Martins and connects with Loch Lomond Road in the City of Saint John. Secondary routes include Route 820 which connects Loch Lomond and Upperton east of the PDA, and Route 865 connecting Norton to Hillsdale.

There are no active rail lines or airfields in Upham Parish. The nearest operational rail line is a Canadian National (CN) Rail line which runs between Moncton and Saint John. There is a CN-owned non-operational spur line between Moosehorn Siding (south of Norton) and the former Cassidy Lake Potash mine. The Saint John Airport is located in Loch Lomond 25 km west of Upham, and another airfield is located in Sussex approximately 23 km northeast of Upham.

5.7.2.2 Employment and Economy

Population

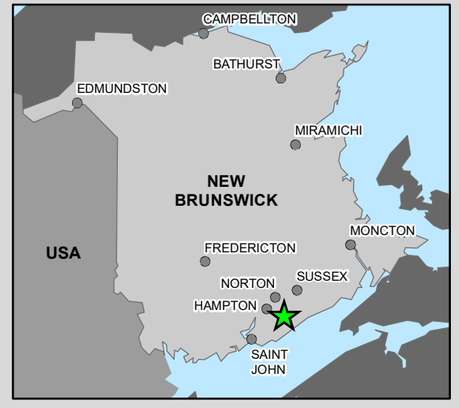
According to the Statistics Canada 2016 Census Profile for Upham Parish Census Subdivision (the smallest census division available for the Project location), the total population in 2016 was 1,269, down 2.8% from 1,306 in 2011. The population density of the parish is 6.7 persons per square kilometre, compared to 10.5 for the province. **Table 5.7.1** shows the distribution by age category for the 2011 and 2016 census years. The age distribution of people living in Upham Parish for the 2016 Census indicates that the largest proportion of the population is in the 25-54 age group, followed by the 0-24 age group. Both of those age groups have decreased between the 2011 and 2016 Census years, while the number of people aged 55 and over have increased (Statistics Canada 2012; 2017).

HAMMOND RIVER HOLDINGS LIMITED
PROPOSED UPHAM EAST GYPSUM QUARRY

REGIONAL SERVICE COMMISSION 8 BOUNDARIES
FIGURE 5.7.1

Brunswick
Havelock
Johnston
Studholm
Cardwell
Sussex
Springfield
Wickham
Waterford
Norton
Sussex
Kars
Norton
Hammond
Hampton
Upham
Hampton
Moncton

- PROJECT LOCATION
- MAJOR CITIES AND TOWNS
- REGIONAL SERVICE COMMISSION (RSC) 8
- LOCAL SERVICE DISTRICTS (LSD)



0 2.5 5 10 km

SCALE 1:400,000

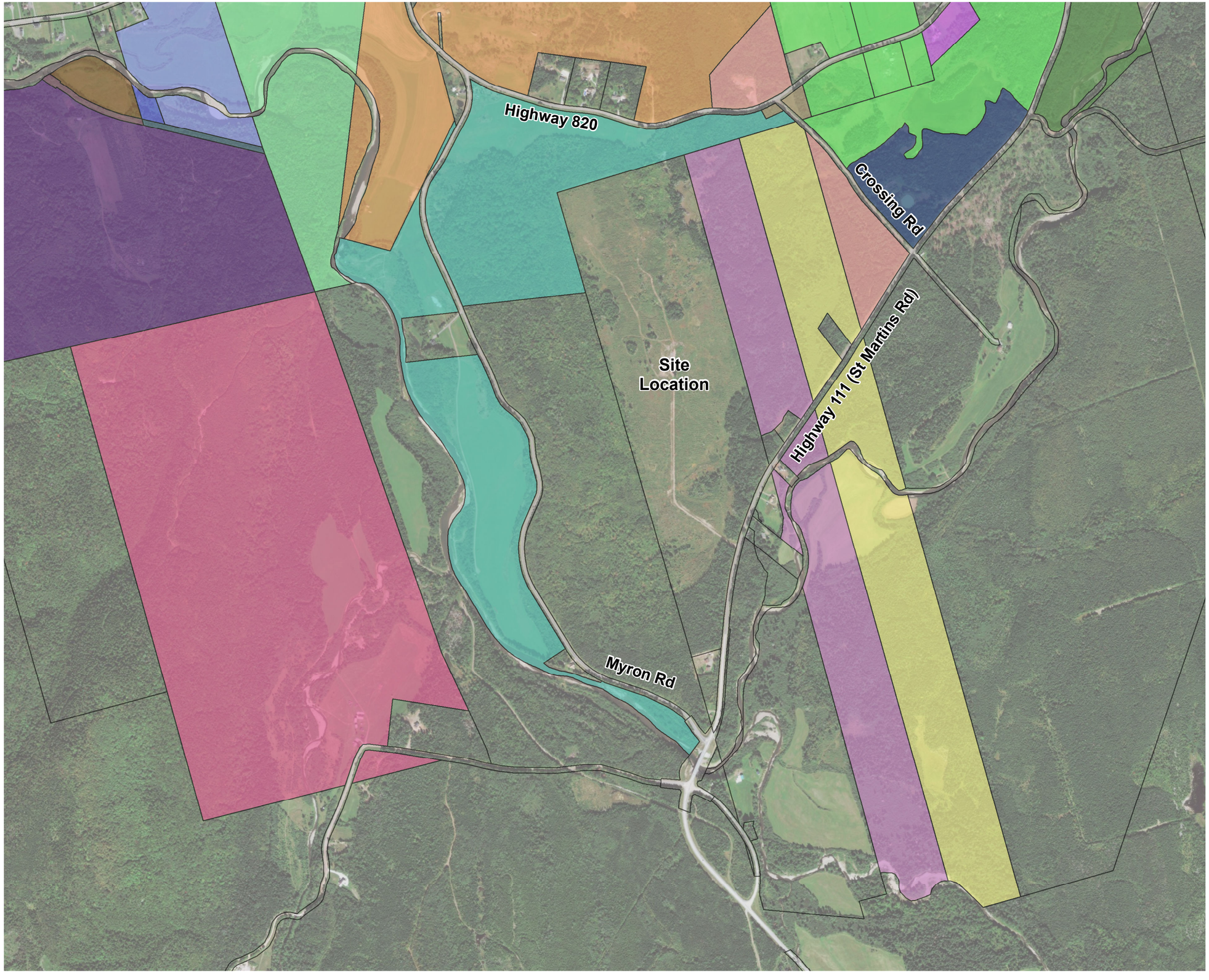
MAP DRAWING INFORMATION:
DATA PROVIDED BY DILLON CONSULTING LIMITED,
SERVICE LAYER CREDITS: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP, GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), SWISS TOPO, OPENSTREETMAP CONTRIBUTORS, AND THE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

MAP CREATED BY: SCM
MAP CHECKED BY: DM
MAP PROJECTION: NAD_1983_CSRS_New_Brunswick_Stereographic

FILE LOCATION: \\DILLON.CA\DILLON_DFS\FREDERICTON\FREDERICTON CAD\CAD\GIS\18346 UPHAM GYPSUM QUARRY\MXD

DILLON CONSULTING

PROJECT: 18-8346
STATUS: FINAL
DATE: OCT 2018



HAMMOND RIVER HOLDINGS LTD.
PROPOSED UPHAM EAST GYPSUM QUARRY

LAND USE IN THE LOCAL ASSESSMENT AREA
FIGURE 5.7.2

LAND USE

- FARMLAND - CULTIVATED (FARMLAND & WOODLOT)
- FARMLAND - PASTURE (BUILDINGS & LAND)
- HOG FARMS (GRAIN BIN & LAND)
- MIXED FARM (RESIDENCE BUILDINGS & LAND)
- MIXED TYPE FARMS (BUILDING & LAND)
- MIXED TYPE FARMS (BUILDINGS & LAND)
- MIXED TYPE FARMS (VACANT LAND)
- MIXED TYPE FARMS (VACANT LAND)
- MIXED TYPE FARMS (VACANT)
- MOBILE/MINI HOMES AND LAND (VACANT)
- RECREATION LAND - UNIMPROVED (VACANT)
- RECREATIONAL LAND - UNIMPROVED (VACANT LAND)
- RESIDENTIAL IMPROVED (RESIDENCE & LOT)
- RESIDENTIAL IMPROVED (RESIDENCE & LAND)
- RESIDENTIAL LOTS - SERVICED (ABANDONED RAILWAY LINE)
- RESIDENTIAL LOTS - SERVICED (VACANT LAND)
- RESIDENTIAL LOTS - SERVICED (VACANT LOT)
- TIMERLAND (VACANT LAND)
- NO LAND USE

0 125 250 500 m

SCALE 1:12,500

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

MAP CREATED BY: JH
MAP CHECKED BY: AS
MAP PROJECTION: NAD_1983_CSRS_New_Brunswick_Stereographic

FILE LOCATION: \\DILLON.CA\DILLON_DFS\FREDERICTON\FREDERICTON CAD\CAD\GIS\188346 UPHAM GYPSUM QUARRY\MXD

DILLON CONSULTING

PROJECT: 18-8346
STATUS: FINAL
DATE: OCT 2018

Table 5.7.1: Age Group Distribution for Upham Parish for 2011 and 2016

Age Group	2011 Census Year	% of Total	2016 Census Year	% of Total	Change 2011-2016
0-24	390	29.77%	350	27.78%	-40
25-54	550	41.98%	475	37.70%	-75
55-64	185	14.12%	220	17.46%	35
65+	185	14.12%	215	17.06%	30
Total	**1310**		**1260**		

Note: Age group totals differ from population totals.
Source: Statistics Canada (2012); Statistics Canada (2017).

Employment and Economy

The Project is located in the Southwest Economic Region which includes Saint John, Kings, and Charlotte Counties. The City of Saint John is the economic centre of the region and holds the largest population in the Southwest Region.

Few people living in Upham Parish work in the parish. The majority (94%) of residents who commute to their place of employment travel outside of the parish to work, and approximately 55% commute outside of Kings County to work. Statistics Canada employment figures for the 2016 Census indicate that the construction industry is the largest employment sector for Upham Parish at 21%, followed by health care and social assistance care and retail trade sectors at 11% and 10%, respectively (Statistics Canada 2017).

5.7.3 Environmental Effects Assessment

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

5.7.3.1 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 quarrying 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 and fracturing of bedrock from blasting has the potential to damage private property.

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

The Project may have a negative effect on residential property values 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 single home-based business (if in existence) are expected to be similar to those on residences in that vicinity.

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 Upham 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 and Resource 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.

Effects on Forestry Land and Resource Use

The PDA was cleared in 2010, and 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. The Project could interact with recreation in the event that sediment-laden water were to enter the Hammond River. Sediment deposition may alter fish habitat by affecting spawning beds, rearing habitat, winter or summer refuge or by affecting food species.

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 35-40 trucks per day will added to the existing traffic on the preferred transportation route. An increase in traffic volume on the preferred transportation route has the potential to reduce the current level of service on roads used for the Project leading to traffic delays, result in degradation of the infrastructure due to higher than normal loads, and result in an increase in the rate of vehicle collisions.

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, rather than relying on a diminishing supply of synthetic gypsum or the

financially unviable alternative of importing natural gypsum from Nova Scotia. Through generation of new employment and maintaining existing jobs at local wallboard facilities, with spin-off employment for third party contractors, the effect of the Project on employment and economy of the region is expected to be an overall positive one.

5.7.3.2 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 111 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. Periodic pre-blast surveys will be conducted at the nearest residences, and blasts will be periodically monitored using seismographs to ensure 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

- There are no commercial or institutional facilities within the LAA that would be expected to interact with the Project except for accidents and malfunctions, thus no mitigation is proposed. 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 cleared in 2010, and no additional land is required 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 conduct a condition assessment of a 9 km section of Route 111 to confirm its weight bearing capacity.
- 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.

5.7.3.3 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 maintenance of acoustic buffers, 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 at nearby 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.

Effects on property values are more difficult to determine, since the literature relating property values to proximity to industrial facilities is uncertain. 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 is ascribed as neutral in this EIA. 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

Given the lack of commercial and industrial facilities in the LAA, no residual effects on commercial and institutional land use are expected. 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 cleared in the early 2010s, and no additional land is required for the Project as currently defined, and as such no interactions with forestry are anticipated. Thus 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 preferred transportation route during operation. However, Route 111 and Route 865 are designated truck routes with suitable weight bearing capacities to accommodate the Project, and as such, damage to road infrastructure or traffic delays arising from an additional 35-40 trucks per day operating on these roads is not expected. Residents located along the preferred 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.

5.7.4 Summary

In summary, the Project may result in a perceived change in land use of the LAA, but since the Project site was logged in the early 2010s, 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 any 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 all phases of the Project are rated not significant, with a high level of confidence.

5.8 Heritage Resources

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

5.8.1 Scope of VC

Heritage resources has been selected as a 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, First Nations have an important interest in the preservation and management of heritage resources related to their history and culture. Furthermore, the Project is within 100-600 m of the Hammond River, which like all major watercourses, carries an elevated potential for harbouring heritage resources. 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. Any Project activity that includes 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 *Heritage Conservation Act* as administered by the New Brunswick Department of Tourism, Heritage and Culture, and are considered to be very 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 Aboriginal origin are specifically 'held in trust' on behalf of First Nations 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).

5.8.1.1 Temporal Boundaries

The temporal boundaries for the Project include the following:

- **Construction:** extending for a period of approximately six months, anticipated to begin in the second quarter of 2019 (subject to the receipt of all approvals and permits required for the Project);
- **Operation:** beginning in approximately the fourth quarter of 2019, 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 61.81 ha (i.e., conservatively assumed to be the entirety of PID No. 00149013) 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).

5.8.1.3 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.

5.8.2 Existing Conditions

To assess the potential for significant adverse residual environmental effects on heritage resources, an archaeological impact assessment (AIA) will be conducted. The details of the 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 First Nation consultation, 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 CRM Group for the components of the AIA are described in the following sections.

5.8.2.1 Archeological 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), consultation/engagement with local individuals and/or groups (including First Nations), and preliminary field investigation (i.e. a walkover) (CRM Group 2018). 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 2018). The specific proposed methods that CRM Group will undertake to complete an AIA for the PDA are outlined below.

Desktop Assessment and Archaeology Field Research Permit (AFRP) Application

Firstly, at the initiation of the AIA, CRM Group will apply for an AFRP for the PDA. For the application process, CRM Group has requested the most recent Archaeological Predictive Model/Recorded Sites Mapping of the PDA from the Archaeological Services Branch of the New Brunswick Department of Tourism, Heritage and Culture (Archaeological Services Branch). This documentation must then be included as part of the AFRP application.

After receiving the model/mapping from the Archaeological Services Branch, a more robust desktop assessment will be initiated to gather historical and environmental information that would contribute to the identification of archaeological potential within the PDA; and, secondly to provide a historical and cultural context within which to evaluate significance of any archaeological resources if they were encountered (CRM Group 2018).

The background research conducted during the desktop assessment will include a review of the following databases and sources that are relevant to the project area (CRM Group 2018):

- Heritage Branch records (including the New Brunswick Archaeological Site File, the Borden Map File, the Archaeological Projects Manuscripts and the Private Collections File, the New Brunswick Plane Crash Inventory, the New Brunswick Cemeteries Database, etc.);
- The Canadian Inventory of Historic Buildings;
- Legal land survey records; and,
- Relevant published and unpublished reports of heritage investigations or surveys within or adjacent to the project area, local and regional history, pre-contact history, architectural history, ethnography, cultural geography and other pertinent disciplines.

Consultation and Engagement with Local Individuals and/or Groups

Consultation/engagement with knowledgeable locals is intended to elicit information on the location, distribution and significance of reported or unreported heritage resources. Groups to be contacted include the First Nation community located nearest to the PDA, as well as organizations, historical societies, collectors, and specialists having local or regional expertise in the history, geology and archaeology of the PDA and surrounding area (CRM Group 2018). Interviews are to be documented and submitted to Archaeological Services as part of the Final Report.

Preliminary Field Assessment

A preliminary field assessment (walkover) will provide exposure to the geographical setting and topography of the PDA. This exposure will facilitate the preparation of the testing strategy for potential future field evaluation stage of archaeological investigation, if one is required. During the preliminary field assessment, potential resources identified as a result of the background research will be examined. However, as it cannot be predicted if archaeological/heritage resources are present, the level of effort assumes that no archaeological or heritage resources will be found during the walkover.

5.8.2.2 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 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.

Although the PDA is located within 50 m of mapped watercourses (i.e., the tips of small unnamed tributaries of the Hammond River that intersect portions of the PDA), these small watercourses would not likely be navigable and thus would not likely have been used as major travel routes by Aboriginal ancestors or colonial people, and as such are not likely to harbour archaeological resources. In addition, the PDA has been previously disturbed through forestry activities, thus putting the PDA in an

area of what is thought to be relatively low archaeological potential. Additionally, though the Hammond River is a major watercourse and could have been used by Aboriginal people for transport, it is located at least 100 m from the edge of the Project site (and up to 600 m, depending on direction), at a distance greater than 50 m from the river (i.e., beyond the high archaeological potential zone). There are historic buildings or other built heritage resources in the PDA, and no such buildings known to be located within 5 km of the PDA. The Upham area is not known to be of interest to provincial regulators due to the presence of fossils or other palaeontological resources. As a result of this preliminary characterization, the potential for heritage resources to be present within the PDA is considered to be low.

5.8.3 Environmental Effects Assessment

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

5.8.3.1 Potential Effects

As a result of the preliminary desktop assessment (including model/mapping database check for high potential resource areas), there is low potential for heritage resources to be located within the PDA. Therefore, subject to confirmation as part of the preliminary field investigation (walkover, and possible subsequent shovel test pitting), there are no potential Project-related environmental effects to heritage resources anticipated.

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**.

5.8.3.2 Mitigation

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 any 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.

The following mitigation measures, through careful design and planning, are recommended to avoid or reduce the potential for adverse interactions with heritage resources:

- Planned avoidance of areas of elevated archaeological potential, to the extend practical;
- Undertake an archaeological evaluation (AIA) of areas proposed for ground breaking through either a field survey (walkover), to determine appropriate mitigation (e.g., shovel testing, archaeological monitoring) to identify archaeological resources that might be present;

- For any areas where shovel testing is recommended following the archaeological field survey, implement this work as per the Archaeological Services (2012) Guidelines;
- Implement archaeological construction monitoring for any ground breaking activities where shovel testing is not practicable;
- Conduct archaeological monitoring and examination of all soil material removed from the river for any artifacts that may have been deposited in the river after eroding from the shoreline areas; and,
- A Project-specific Environmental Protection Plan (EPP) with defined contingency and emergency response procedures will be developed and implemented.

If heritage resources are accidentally identified at any point 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 Archaeological Services 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 any uncovered object; and,
- Activities at the site may resume only when authorized by Archaeological Services 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.

5.8.3.3 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.

Based on the early results of the AIA being developed for the Project, the Project site generally has a low potential for harbouring archaeological resources, although the presence of the nearby Hammond River approximately 100-600 m from the Project site (depending on direction) could indicate potential for heritage resources to be found in the general area of the Project. A site walkover and associated shovel testing of the Project site will confirm the low to moderate archaeological potential. For palaeontological resources, given the presence of 10-20 m of overburden currently covering the gypsum

deposit, the presence of fossils in the underlying gypsum rock is highly unlikely. No built heritage resources are located in the PDA.

Based on these observations, and with the implementation of planned mitigation, substantive interactions between the Project and heritage resources are unlikely to occur.

5.8.4 Summary

Based on the preliminary desktop assessment conducted by CRM Group and Dillon, the PDA is located within an area that is believed to be of lower archaeological potential. The potential for heritage resources to be present within the PDA is therefore also considered low; therefore, substantive interactions between the Project and heritage resources are thus unlikely to occur.

In light of these observations, and with the implementation of the mitigation and environmental protection measures described in this section, it is not anticipated that there will be any substantial unmitigated interaction between the Project and heritage resources during the Project. Pre-construction archaeological surveys, and/or archaeological monitoring and/or examination during all ground breaking activities will result in the identification of any archaeological resources, and development of appropriate mitigation in the event that any archaeological resources are present in areas identified for ground disturbing construction or operation activities. Therefore, in consideration of the above, the residual environmental effects of the Project on heritage resources during all phases of the Project are rated 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.

5.9 Traditional Land and Resource Use

The potential environmental effects of the Project on traditional land and resource use are assessed in this section.

5.9.1 Scope of VC

Traditional land and resource use refers to the practice of traditional activities by Aboriginal persons, including hunting, fishing, trapping, and gathering in pursuit of a moderate livelihood. 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 Aboriginal 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 First Nation communities 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.

5.9.1.1 Temporal Boundaries

The temporal boundaries for the environmental effects assessment of traditional land and resource use are defined through three phases:

- **Construction:** extending for a period of approximately six months, anticipated to begin in the second quarter of 2019 (subject to the receipt of all approvals and permits required for the Project);
- **Operation:** beginning in approximately the fourth quarter of 2019, 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

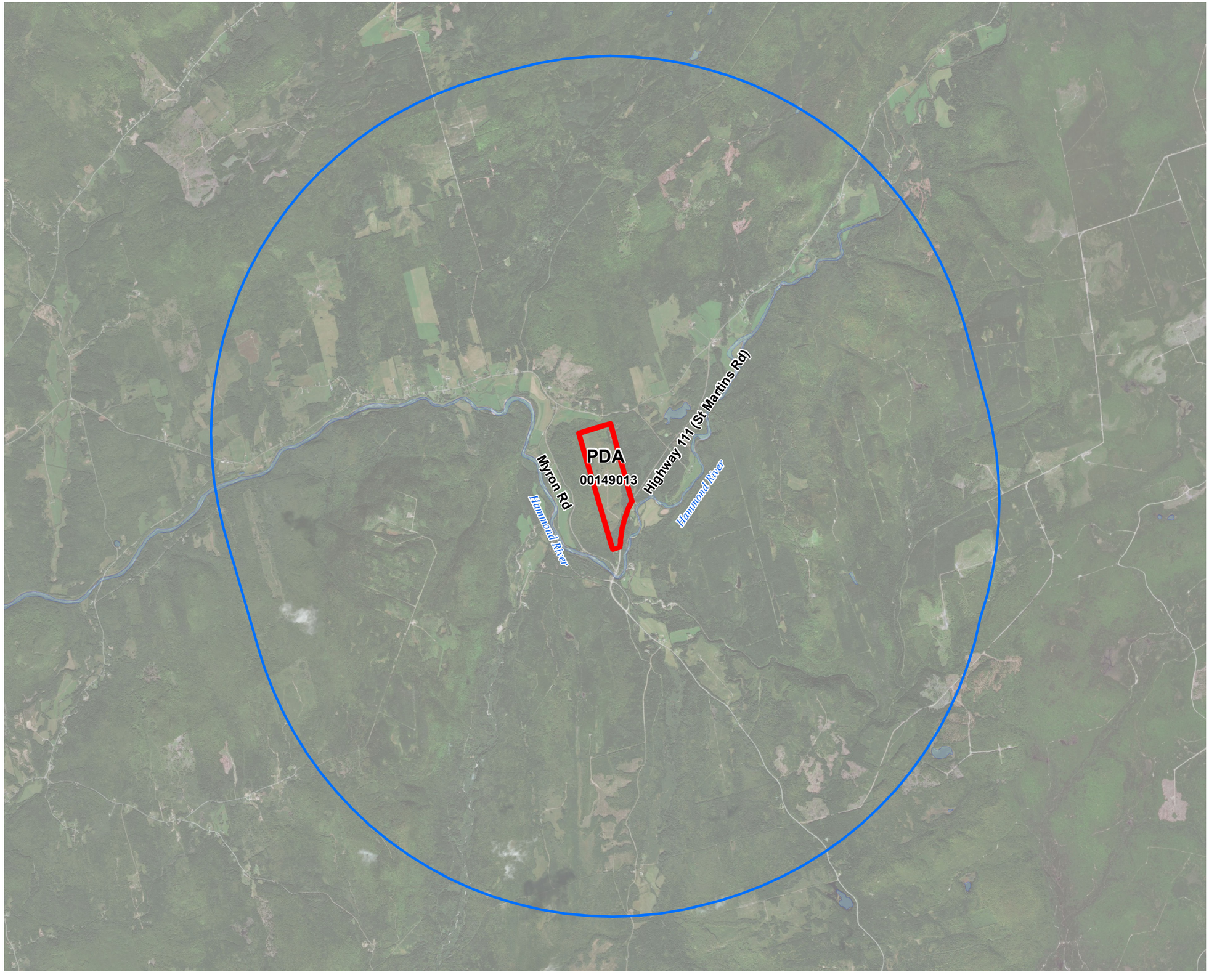
The spatial boundaries of the environmental effects assessment completed are shown in **Figure 5.9.1**, and are described as follows.

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 61.81 ha (i.e., conservatively assumed to be the entirety of PID No. 00149013) 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, 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 5.9.1**) for traditional land and resource use consists of an area of 24,417 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 to assess and consider potential biophysical and atmospheric effects from the PDA and areas where Project-related environmental effects might be expected to occur.

5.9.1.3 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 used by Aboriginal persons for traditional purposes within the LAA or PDA that cannot be mitigated.



HAMMOND RIVER HOLDINGS LIMITED
PROPOSED UPHAM EAST GYPSUM QUARRY

SPATIAL BOUNDARIES FOR TRADITIONAL LAND AND RESOURCE USE
FIGURE 5.9.1

- LOCAL ASSESSMENT AREA (LAA)
- WATERCOURSE
- PROJECT DEVELOPMENT AREA (PDA)



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: BQS
MAP REVISED BY: JH
MAP CHECKED BY: DM
MAP PROJECTION: NAD_1983_CSRS_New_Brunswick_Stereographic

FILE LOCATION: \\DILLON.CA\DILLON_DFS\FREDERICTON\FREDERICTON CAD\CAD\GIS\188346 UPHAM GYPSUM QUARRY\MXD

DILLON CONSULTING

PROJECT: 18-8346
STATUS: FINAL
DATE: OCT 2018

5.9.2 Existing Conditions

5.9.2.1 Project Context

The Project is located in the Local Service District (LSD) of Upham, within Kings County, New Brunswick. The Hammond River, a tributary of the Kennebecasis River, meanders through the LAA and is located within 1 km of the PDA. The PDA is also surrounded by agricultural and forested lands.

The Project is at an early developmental stage, and consultation with First Nations about the Project has only been recently initiated. The consultation process is intended to support an improved understanding of the traditional land use of the PDA, but given the early stages of such consultation at the time of submission of this EIA registration, no specific information has been obtained from First Nations in relation to potential concerns they may have or if or how they are/have been using the PDA or LAA for the practice of traditional activities. It is expected that such information will be gained over time through an understanding of current practices as engagement of First Nations is conducted, and perhaps through the development of a traditional land and resource use (TLRU) study, should one be requested by First Nations. As a result, in the absence of specific information from First Nations, it can be assumed that lands and resources near the Project could have been, and are currently being used for traditional purposes by the Wolastoqey (Maliseet) Nation (and possibly other First Nation communities). The Project site is located within what has been traditionally recognized as the Wolastoqey Nation's traditional territory, although the PDA is located within the Title Claim submitted to the Court of Queen'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 Aboriginal peoples as part of their traditional territory, and it is possible that the Mi'kmaq peoples might have also used those lands for traditional practices. Construction and operation of the Project may affect or alter the ability of First Nations 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.

Documented details on how and where traditional activities have been or are taking place may exist, but they are normally held confidentially by First Nations and their representative organizations. This knowledge is both valuable and private to the rights holders (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 First Nation knowledge over the coming months, should the Nations decide to do so. First Nation knowledge of traditional land and resource use(s) within the PDA and LAA will be obtained from planned discussions with First Nation 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.

5.9.2.2 First Nation Community Context

New Brunswick's First Nations assert 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 First Nations in respect of decisions made by the Crown that might affect these constitutionally-protected Aboriginal or 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 Aboriginal Affairs Secretariat (GNB 2011).

Historically, the lands of Central New Brunswick have been used by Aboriginal persons for traditional uses such as hunting, fishing, gathering, trapping, subsistence, and related purposes (Goddard 1996). As shown in **Figure 5.9.2**, according to secondary literature, Wolastoqey traditional territory is understood to be comprised of the greater Saint John River watershed as far north as the Gulf of St. Lawrence to Québec City, east through the state of Maine where it meets the Passamaquoddy territory, south to the Bay of Fundy, and west where it meets the neighboring Mi'kmaq nations (Goddard 1996). This interpretation of the traditional territories of New Brunswick originates from the "Ganong line" proposed by W.F. Ganong (a botanist, historian, and cartographer) in 1901, but this line is generally not accepted by First Nations in New Brunswick. While it has been common practice for these principles to be applied in understanding the traditional territories of the Nations of New Brunswick, the Wolastoqey and Mi'kmaq peoples have asserted that all of New Brunswick makes up part of their traditional territories.

Figure 5.9.2 shows the 15 First Nations communities within the province of New Brunswick, consisting of six Wolastoqey Nation communities and nine Mi'kmaq Nation communities. Wolastoqey communities and their traditional territory are generally located along the Saint John River valley, while the Mi'kmaq communities are predominantly located along the northern and eastern coastal regions of the province. Though the Project is thought to be located in Wolastoqey traditional territory, First Nations peoples migrated through the entirety of the lands in New Brunswick for millennia and as such, it is possible that the Mi'kmaq peoples might have also used the lands and resources of southern New Brunswick.

5.9.2.3 Population Demographics

The 2016 Census identified approximately 4% of the New Brunswick population as having Aboriginal identity, or the equivalent of 29,385 persons in New Brunswick. The population of Indigenous band members on-reserve, as reported by Indigenous and Northern Affairs Canada (INAC 2018), is provided in **Table 5.9.1**.

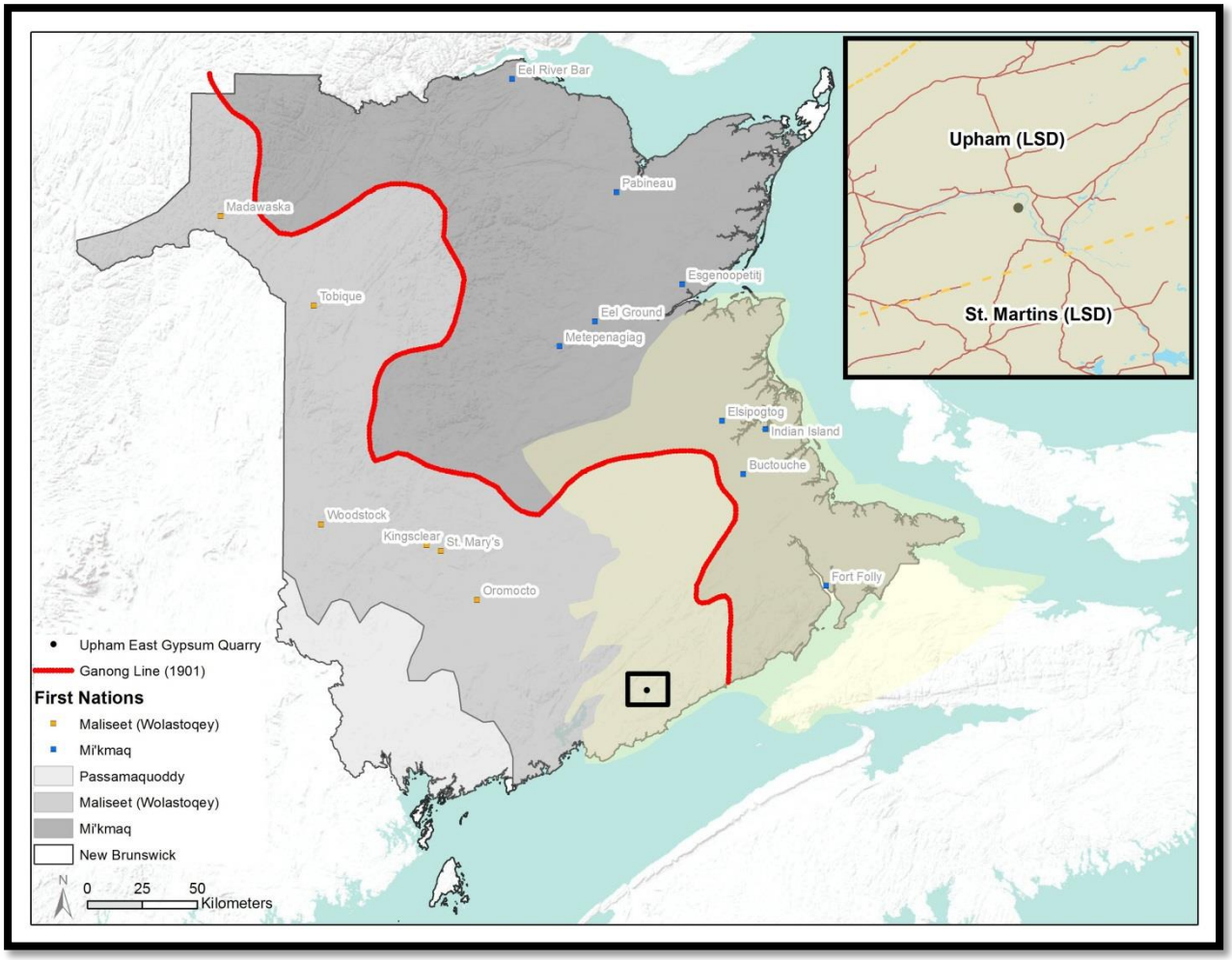


Figure 5.9.2: First Nations Communities in New Brunswick

Table 5.9.1: Population of Indigenous Band Members On-Reserve (2016)

First Nation Community	2016 Population (On-Reserve)
Wolastoqey (Maliseet) First Nations in New Brunswick	
Oromocto First Nation	707
St. Mary's First Nation	1,927
Kingsclear First Nation	1,040
Woodstock First Nation	1,079
Tobique First Nation	2,484
Madawaska Maliseet First Nation	374
Sub-total	**10,611**

Table 5.9.1: Population of Indigenous Band Members On-Reserve (2016)

First Nation Community	2016 Population (On-Reserve)
Mi'kmaq First Nations in New Brunswick	
Eel River Bar First Nation	750
Pabineau First Nation	324
Esgenoopetitj First Nation	1,923
Metepenagiag First Nation	698
Eel Ground First Nation	1,063
Indian Island First Nation	200
Elsipogtog First Nation	3,372
Buctouche First Nation	124
Fort Folly First Nation	132
Sub-total	**8,586**
Total On-Reserve First Nation Population in New Brunswick (2016)	**19,197**

Source: INAC (2018)

There are currently no First Nation communities located within or immediately near the PDA or LAA. The closest First Nation communities to the Project are the Oromocto First Nation, located approximately 88 km to the northwest of the PDA; the Fort Folly First Nation, located approximately 96 km to the northeast of the PDA; and St. Mary's First Nation, approximately 112 km to the northwest of the PDA. In addition to these identified First Nation communities, there is one additional reserve – The Brothers #18 – which consists of two small islands located within the Kennebecasis Bay, 4 km north of the City of Saint John and approximnately 42 km southwest of the Upham East Project site. The Brothers #18 Reserve is jointly managed by Kingsclear, Madawaska, Tobique, and Woodstock First Nations. The Brothers #18 Reserve is a traditional gathering place, but contains no permanent residences.

In 2016, the Elsipogtog Mi'kmaq 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 5.9.2**) displays that the Project site (PDA) is currently situated within the Elsipogtog Mi'kmaq First Nation Land Claim. The assertion of title produced by the Elsipogtog Mi'kmaq 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.

5.9.2.4 Current Use 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 a traditional land and resource use (TLRU) study (sometimes called a traditional knowledge (TK) study). However, while First Nations were informed of planned exploration drilling activity for the Project as part of the issuance of a exploration permit by NBDERD, Hammond River Holdings has only recently begun engaging Aboriginal communities more formally in respect of the Project through an introduction letter sent to the Chiefs of the 15 First Nation communities in New Brunswick in mid-October 2018, 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). Furthermore, a TLRU study has not been requested or conducted at this time, though Hammond River Holdings will consider such requests if they are made by the Chiefs or representative organizations.

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 Hammond River and some larger tributaries) would have been used at some time for fishing and navigation by Aboriginal persons (although the use of on-site watercourses WC1-WC4 for such purposes is unlikely, given their small size), and that the lands would have been used by Aboriginal 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 privately-owned land, it is conservatively assumed that the PDA has been and is being used for practicing traditional activities by Aboriginal persons, at the convenience of the landowner. Further specific information in this regard is expected to be obtained through engagement of Aboriginal communities, as engagement progresses.

5.9.2.5 Traditional Resources in the PDA, and Traditional Use Perspective of those Resources

The terrestrial and aquatic habitats present within the PDA were surveyed from a traditional knowledge perspective by a member of Tobique First Nation (TFN) who accompanied Dillon's biologists during the field surveys conducted on August 29 and 30, 2018. Based on the knowledge of the member of TFN, the Project area did not offer unique habitat or flora or fauna species of special significance to traditional activities or uses. However, although the PDA is virtually absent of mature vegetation, several common plant species that could be found in the remaining uncut portions of the PDA (and possibly formerly present in the cut portion of the PDA, based on observation of similar habitat types on adjacent properties) are known to be used for traditional medicinal and food purposes by many First Nations groups (Bear, D., pers. comm., 2018). These species include, but are not limited to:

- balsam fir (*Abies Balsamea*) and white pine (*Pinus Strobus*), both known to be a source of Vitamin C and providing a variety of medical uses; and,

- white ash (*Fraxinus americana*) and golden thread (*Coptis trifolia*), together traditionally used to treat deafness).

Additionally, many of the tree and shrub species present within the PDA (refer to the vegetation species lists provide in **Appendix C**) can provide seeds and fruits for seasonal food sources or are dried for winter consumption. The trees are also used as a famine food source by scraping the cambium layer for cooking. Other traditional uses for trees remaining in the uncut portions of the PDA (as well as for those thought to be formerly present within the PDA) include traditional canoes and storage containers that were often made from the bark of white birch (*Betula papyrifera*) (Bear, D., pers. comm., 2018). However, as these species are common and widely distributed throughout New Brunswick (except for golden thread, which is rare but not likely present in the PDA), the Project is not expected to adversely affect the practice of traditional gathering activities in the LAA.

There are no traditional activities such as hunting, snaring or gathering known to occur within the PDA.

5.9.3 Environmental Effects Assessment

The environmental effects of the Project on traditional land and resource use are assessed in this section.

5.9.3.1 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, 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 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. This effect will continue throughout the construction and operation phases, but will be restored upon site reclamation.
- 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 Aboriginal 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.

5.9.3.2 Mitigation

Traditional land and resource is 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), and **Section 5.8** (heritage resources). Those mitigation measures are also applicable to this particular VC. In addition, the following mitigation measures through careful design and 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 First Nations throughout the Project to exchange information, address concerns, and assist in the development of management and reclamation plans for the Project.
- If requested, First Nation 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 to ensure the land is accessible for traditional purposes at some time in the future following closure of the Project.
- Fish and fish habitat will be monitored to ensure water flows are appropriate to mitigate bank erosion.
- Affected fish habitat and wetland habitat that is lost to the Project will be authorized under federal and provincial legislation and compensated.
- Wildlife and wildlife habitats within the PDA will be re-vegetated upon closure, which will partially restore habitat conditions in the PDA, over time.

5.9.3.3 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. Though 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. 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, First Nation 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.

Traditional land uses which are likely currently being performed in the LAA, including hunting, fishing, camping, and timber harvesting, have not been confirmed, but have been conservatively assumed to be taking place for traditional purposes; and will be minimized through the careful design of Project-related facilities and infrastructure to ensure that the size of the PDA is limited to the area necessary for safe and efficient operation of the proposed quarry. The southern and southeast portions of the Project site will be left as is as much as possible, forming a vegetated buffer of mature trees, which will diminish noise levels extending outward to the LAA. Though indirect effects to wetlands and watercourses on neighbouring properties are possible, vegetation/tree buffers surrounding wetlands and watercourses on the southern end of the PDA will also be maintained to the extent possible to preserve habitat and reduce effects on the aquatic and wetland environments.

Furthermore, given the relatively small size of the PDA (i.e., 61.81 ha) in comparison to that of the LAA (i.e., 24,417 ha) or the much larger asserted traditional Wolastoqey territory (i.e., the Saint John River watershed, an area of approximately 55,000 km^2 or 5,500,000 ha), it is believed that the access to and availability of similar land and resources within the larger traditional territory within the LAA or beyond will not be impeded, and Aboriginal traditional activities that are currently practiced in the rest of the traditional territory will not be substantively interfered with. As noted in other VCs (e.g., fish and fish habitat, wildlife and wildlife habitat, vegetation and wetlands), there are no features of the LAA that are unique in terms of habitat, presence of wildlife, or presence of species at risk or species of conservation

concern; therefore the loss of access to land or resources in the PDA is not anticipated to affect the current use of traditional land and resource use in a substantive way, as these resources are available nearby as well as in other nearby parts of the Wolastoqey's traditional territory.

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 First Nations communities (upon the advice of the Aboriginal Affairs Secretariat; Mann, M., pers. comm., 2018) 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 First Nations, a TLRU study may be conducted to identify specific current traditional uses in the PDA that might require accommodation. 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.

5.9.4 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.

Consultation with First Nations about the Project has only been recently initiated, and is intended to support an improved understanding of the traditional land use of the PDA. Ongoing engagement with the First Nations 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. If requested by First Nations, a TLRU study may be conducted to identify specific current traditional uses in the PDA that might require accommodation.

In summary, the PDA represents a very small percentage of the lands in the Saint John River watershed (i.e., the Wolastoqey traditional territory), and given that the PDA consists of privately owned land and has been logged in the past decade, subject to confirmation by First Nations through engagement, it is unlikely that the Project site is considered to be important to the practice of Aboriginal 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 for any 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 all phases of the Project are not anticipated to result in significant environmental effects on the use of land or resources by the Wolastoqey or Mi'kmaq peoples that may practice traditional activities in the LAA, subject to confirmation by First Nations through engagement. This prediction is made with a moderate level of confidence due to the limited engagement of First Nations 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 First Nations and a TLRU study if requested by First Nations, will improve the level of confidence in this prediction.

There is no follow up or monitoring proposed for this VC, but monitoring approaches within both **Sections 5.4 and 5.5** will need to be addressed. Hammond River Holdings will continue to consult with First Nation communities to appropriately address Project-specific issues related to residual environmental effects, and additional work and/or monitoring may be required pending the results of the engagement process.

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 six months, anticipated to begin in the second quarter of 2019 (subject to the receipt of all approvals and permits required for the Project);
- Operation: beginning in approximately the fourth quarter of 2019, 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 61.81 ha (i.e., conservatively assumed to be the entirety of PID No. 00149013) 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 Saint John "A" weather station, located at the Saint John airport, approximately 27 km east of the PDA. The weather station provides historical data for wind, temperature and precipitation, amongst other variables. The most recent 30-year period for which climate normals data are available from the Saint John A weather station is for the period of 1981 to 2010, and data were summarized in **Table 5.2.2**. This period has been chosen as the most applicable period for summarizing current climate conditions for the Project (GOC 2018).

Monthly mean wind speeds measured at the Saint John A weather station range from 11.3 to 17.5 km/h, with an annual mean wind speed of 15.2 km/h. From May to August, the dominant wind direction is from the south, with winds predominantly blowing from the southwest and northwest from September to February (GOC 2018). Maximum hourly wind speeds, averaged from 1981 to 2010 for each month, range from 61 km/h to 111 km/h, while maximum wind gusts for the same period range from 96 km/h to 148 km/h. Occurrences of extreme winds are relatively uncommon at the reference weather station. From 1981 to 2010, there has been an average of 17.3 days per year with winds greater than or equal to 52 km/h and 3.8 days per year with winds greater than or equal to 63 km/h (GOC 2018).

Precipitation at the Project site, 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 1,295.5 mm of precipitation per year, of which 1,076.0 mm was rain and 239.6 mm was snowfall (as water equivalent). Extreme daily precipitation in the past century has ranged from 66.5 mm (May 1967) to 154.4 mm (November 1975). On average, there have been 12.7 days each year with rainfall greater than 25 mm, and snowfalls greater than 25 cm occur on average 0.63 days each year (GOC 2018).

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 any other decade on record, while Saint John had the highest number of events during the 1960s. The trends were different in all 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 2018c).

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 (GOC 2018). Flooding in New Brunswick is rather common, especially along the Saint John River (ECCC 2017). While the Hammond River, located adjacent the Project site, is not known as being highly flood prone, ice jams and localized flooding are possible during spring freshet.

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 (GOC 2018).

Tornadoes are rare in New Brunswick, but can occur. According to Environment and Climate Change Canada, western New Brunswick is considered part of Canada's Tornado zone, a region that stretches from the B.C-Alberta border to the western portion of New Brunswick. The Project site is located within this area. However, no tornadoes have been documented at or near the PDA.

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 2018a). 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 southeastern 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, any 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.

In summary, a review of historical earthquake records and regional tectonics indicates that the Project area is situated in a region of low seismicity.

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 2018b).

The mean Fire Weather Index in Upham, New Brunswick for July (i.e., normally the driest month of the year), when risk of forest fire is typically greatest, is rated from 5-10, as shown in **Figure 6.2.1**, which is the second 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 2018b).

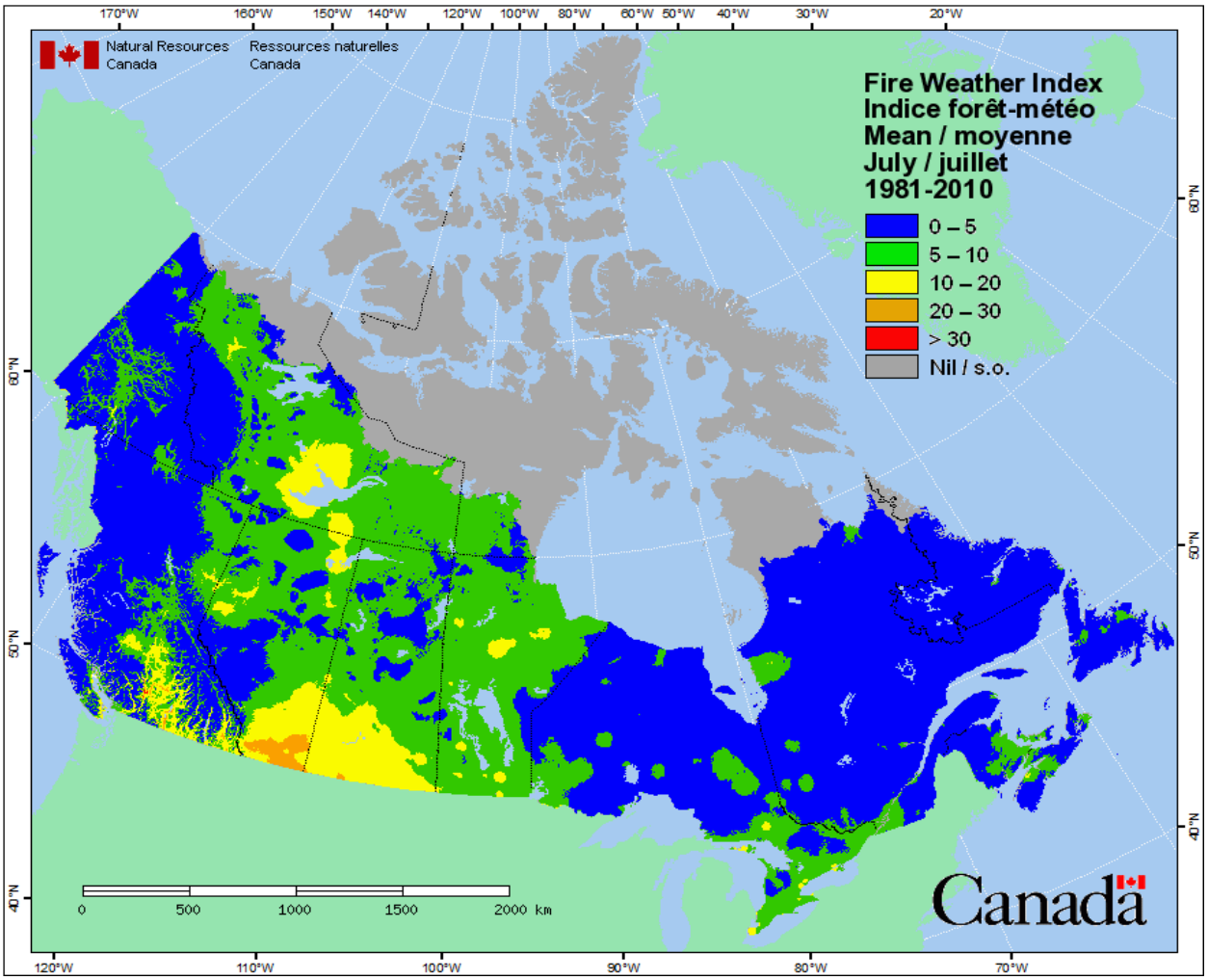


Figure 6.2.1: Natural Resources Canada Fire Weather Index

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 any 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:

- wind loads;
- storm water drainage from rain storms and floods;
- weight of snow and ice, and associated water;
- earthquake loads; 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 Upham, 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 Upham 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. Many believe that these changes to the climate regime will 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 manoeuver 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**.

Effects of Seismic Activity on the Project

Although the Project area is geographically situated within an identified seismic zone, the level of historical seismic activity near the PDA is low. Other areas of the province (such as the Passamaquoddy Bay region, the Miramichi region, and the Moncton region) have historically experienced relatively higher levels of seismic activity, but these are sufficiently distant to the Project that the risk that a major seismic event in these areas could adversely affect the Project in a significant way is low. Although past occurrence of seismic activity in an area is not necessarily an indicator that a significant seismic event could not occur in the future, the likelihood of a major seismic event in the immediate vicinity of the Project that could cause major Project damage or interrupt activities during any phase of the Project is low.

Effects of Forest Fires on the Project

New Brunswick has a forest fire control program in place to identify and control fires, minimizing the potential magnitude and extent of any forest fire, and their potential consequent effects on the Project. Local and provincial emergency response crews will provide for rapid detection and response to any identified fire threat. 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 23 ha open pit) provides a safety and fire buffer, further decreasing the likelihood of a forest or brush fire causing substantive damage to the Project.

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

- The materials specified for the Project will be in compliance with the applicable standards and codes and will maintain structural integrity at the anticipated minimum and ambient temperatures near the PDA to prevent damage to Project infrastructure that could pose a substantial health and safety risk, could delay the Project schedule and milestones, or could not be technically or economically repaired.
- 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 is being designed with storm allowances for containment of largest design storm event (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 any 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 any 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.
- Any building structures (e.g., gatehouse, portable trailer) will be designed such that they will be able to withstand extremes of temperature, wind, rain, snow, and ice events through the life of the Project. Structures will be designed to withstand these weather-related factors and loads, in consideration of future climate changes, and to be in compliance with applicable codes and standards.
- Contingency plans, including emergency back-up power (e.g., solar panels, generator) for necessary operations, will be in place to manage temporary power outages.

As described above, environmental stressors potentially associated with climate change and severe weather would be more than adequately addressed by engineering design to comply with building codes and standards that incorporate factors of safety to account for these changes, and careful materials selection for Project-related infrastructure. The National Building Code of Canada provides for factors of safety to account for possible extreme weather (including allowances for future increased frequency and/or severity of these storms that could arise from climate change), and will form the basis of the design and construction of the Project-related infrastructure.

Mitigating Effects of Seismic Activity on the Project

The Project and related infrastructure will be designed to the applicable standard in consideration of the maximum credible earthquake magnitude for the region. The National Building Code of Canada provides for sufficient factors of safety to account for seismic activity in active seismic zones in Canada, and will form the basis of the design and construction of site infrastructure. The intent of these and other design standards is to maintain the integrity of the facilities based on the level of risk for an earthquake in the area of a magnitude up to the maximum credible earthquake. Therefore, seismicity is not considered to have the potential to substantively damage project infrastructure or components during all phases of

the Project, due to planned design mitigation and the application of the National Building Code of Canada and other applicable guidelines.

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 design and building codes and standards are expected to account for weather extremes, seismicity, 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 to ensure 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 (e.g., seismic events, fires), would more than adequately be addressed by good engineering design, 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 any phase of the proposed project. 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 Erosion and Sediment Control (ESC) Measures: 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 ESC measures could occur during the construction or operation phases of the Project.

Uncontrolled Explosion: 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.

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 collisions, 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	Socioeconomic Environment	Heritage Resources	Traditional Land and Resource Use
Slope Failure						✓		
Failure of Erosion and Sediment Control Measures		✓	✓	✓	✓			✓
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 all phases 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*;
- Quarry face inspections will occur daily to ensure compliance; 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 Erosion and Sediment Control Measures

Erosion and sediment control (ESC) measures prevent erosion of surface soils and the resulting surface runoff from directly entering surface water bodies. Failure of ESC measures 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 ESC measures 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. Consequential environmental effects could result to surface water, vegetation and wetlands, and wildlife and wildlife habitat.

In addition, a failure of ESC measures could affect traditional land and resource use as a consequential environmental effect. Aboriginal 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 very low. With the implementation of mitigation measures, contingency and emergency response procedures, and best practices, the potential residual environmental effects of a failure of erosion and sedimentation control measures 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 Explosion

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 either be transported to the Project site by a licensed blasting subcontractor on a daily basis, or stored on site in an approved and properly designed explosives magazine that meets setback and security requirements of the *Explosives Act*, thereby removing the risk of unauthorized access to explosives.
- 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*.
- Periodic pre-blast surveys will be conducted at the nearest residences, and blasts will be periodically monitored using seismographs to ensure 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 all phases 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, and/or wildlife and wildlife habitat.

Vehicles will be active across the Project site throughout the construction and operation phases as well as on the transportation route between Upham East 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 in the event of vehicle-to-wildlife 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 optimize safety by using 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 111 and Route 865, 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 Hazardous Materials

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 Aboriginal 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.

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.
- No storage of hazardous materials will occur on-site; all hazardous materials 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 all phases 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 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, although the presence of the nearby Hammond River approximately 100-600 m from the Project site (depending on direction) could indicate a potential for heritage resources to be found in the general area of the Project. A site walkover and associated shovel testing (as required) of the Project site will confirm the low to moderate archaeological potential. For palaeontological resources, given the presence of 10-20 m of overburden currently covering the gypsum deposit, the presence of fossils in the underlying gypsum rock is highly unlikely.

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 any 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 Archaeological Services 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 any uncovered human remains.
- If the discovered resources are related to Aboriginal culture, the New Brunswick Aboriginal Affairs Secretariat 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 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 very 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 all phases 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 any work is initiated on the proposed Project so that incidents can be managed effectively. By ensuring that all aspects of the Project adheres to applicable codes and standards and implementing the mitigative measures outlined above, the potential for adverse environmental effects arising from accidents, malfunctions, or unplanned events is greatly reduced.

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 all 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 all phases of the Project are rated not significant, with a high degree of confidence.

8.0 Summary of Residual Effects and Mitigation

8.1 Overall Summary

The environmental effects assessment of the VCs described throughout **Section 5.0** of this report concluded that there would be no significant adverse residual environmental effects from the Project during all phases assessed and in consideration of normal activities of the Project, as planned. 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.

Positive environmental effects were predicted for the socioeconomic environment as they relate to employment during the operation phase of the Project.

The following table summarizes the environmental effects assessment for each VC (refer to **Section 5.0** for details) and for each identified potential accident, malfunction or unplanned event (refer to **Section 7.0** for details). A concise summary of project phase(s) and potential interactions, identified mitigation, and significance of residual effects and follow-up measures that were identified are provided in **Table 8.1.1** below.

Table 8.1.1 - Summary of Residual Effects and Mitigation

Project Phase(s)	Potential Effects	Mitigation	Significance of Residual Effect(s)
Atmospheric Environment (refer to Section 5.2)			
Construction, Operation, Reclamation and Closure	• 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 heavy mobile equipment and on-site trucks during construction and operation could result in emissions of greenhouse gases. • Emissions during reclamation and closure are expected to be similar to those during construction.	In addition to the standard mitigation measures and best management practices, the following mitigative measures will be employed: • 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.	No significant residual effects identified. **Confidence level:** High **Magnitude:** Low **Spatial Extent:** Local **Duration:** Short term **Reversibility:** Reversible
Water Resources - Groundwater and Surface Water (refer to Section 5.3)			
Construction, Operation, and Reclamation and Closure	• 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 several wetlands and unnamed streams are likely to be affected. • The ongoing presence of the open pit 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. • Localized water balance may be disrupted through groundwater flow redirection towards the open pit rather than towards the Hammond 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. • 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 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. • Many of the wetlands on the site will either be reduced in size or be destroyed during the construction and operation phases of the Project.	In addition to the standard mitigation measures and best management practices, the following mitigative measures will be employed: • Where possible, avoid construction within 30 m of watercourses or wetlands. • The area of disturbance will be minimized to the extent possible to limit the associated environmental effects. • Proper erosion and sediment control measures will be installed and checked regularly and prior to and after storm events to ensure 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). • An Environmental Protection Plan (EPP) including spill response measures will be put in place to establish procedures to minimize the potential for spills or uncontrolled releases. • It is planned that up to 20 potable wells in the LAA will be sampled 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 2017) prior to the beginning of construction. • 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 during construction and operation of the Project. A groundwater monitoring plan will be developed as part of the permitting phase of the Project.	No significant residual effects identified. **Confidence level:** Moderate Follow up monitoring recommended. **Magnitude:** Low **Spatial Extent:** Local **Duration:** Short term **Reversibility:** Reversible

Project Phase(s)	Potential Effects	Mitigation	Significance of Residual Effect(s)
Fish and Fish Habitat (refer to Section 5.4)			
Construction, Operation, Reclamation and Closure	• Construction activities have the potential to result in the direct loss of fish and/or fish habitat in areas to be occupied by the open pit or other surface facilities and related flow diversions; • Construction and operation could also result in the indirect loss of fish and/or 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); • Removal of surface materials including vegetation and soils (i.e., topsoil and overburden) 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 untreated surface water, or out of specification treated water, 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(s) 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.	In addition to the standard mitigation measures and best management practices, the following mitigative measures will be employed: • The area to be disturbed by the Project will be minimized to the extent possible; • 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; • Maintaining a 30 m buffer around watercourses and wetlands, or if not possible, obtaining a watercourse and wetland alteration (WAWA) permit for any alterations of watercourses and their 30 m buffers; • Obtaining an authorization under Section 35(2) of the Fisheries Act for any Project activities that would result in the loss of fish habitat or other activities that result in serious harm to fish (as determined by DFO), with appropriate offsetting; • Efforts will be made to maintain as much mature vegetation that remains along the edges of the site as possible; in particular buffers around watercourses and wetlands located on the southeastern and southwestern portions of the PDA will be maintained to the extent possible; • 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; • Release of 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; • Implement requirements for blasting as outlined in the DFO Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters; • Proper erosion and sediment control measures will be installed and checked regularly and prior to and after storm events to ensure they are continuing to operate properly; and, • An emergency response plan (ERP) for accidental spill and emergencies 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.	No significant residual effects identified. **Confidence level:** Moderate Follow up monitoring recommended. **Magnitude:** Low **Spatial Extent:** Local **Duration:** Short term **Reversibility:** Considered reversible through the implemetation of required habitat compensation

Project Phase(s)	Potential Effects	Mitigation	Significance of Residual Effect(s)
Vegetation and Wetlands (refer to Section 5.5)			
Construction, Operation and Reclamation and Closure	• The construction and operation phases of the Project will result in the direct loss of approximately 4.78 ha of unmapped (field identified) wetlands within the PDA;no regulated (mapped) wetlands are located in the PDA; • The construction and operation phases of the Project may result in the indirect loss of wetland area or function associated with a regulated (mapped) wetland on a neighbouring property within the LAA (on the northeast corner of the PDA), which is connected to WL3 and WC1; • 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; and, • 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 wetland restoration within the PDA).	In addition to the standard mitigation measures and best management practices, the following mitigative measures will be employed: • The area to be disturbed by the Project will be minimized to the extent possible; • 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; • Potential installation and/or upgrades to watercourse crossings (culverts) will be designed as per the New Brunswick Watercourse and Wetland Alteration (WAWA) Guidelines; • Efforts will be made to maintain as much mature vegetation along the edges of the site as possible; in particular buffers around wetlands located on the southeastern and southwestern portions of the PDA will be maintained to the extent possible; • Potential installation and/or upgrades to watercourse crossings (culverts) draining to wetlands will be designed as per the New Brunswick Watercourse and Wetland Alteration (WAWA) Guidelines; • Obtaining a watercourse and wetland alteration (WAWA) permit for any alterations to regulated wetlands (and their 30 m buffers); • Construction and operation activities will comply with the conditions of the WAWA permit; • Proper erosion and sediment control measures will be installed and checked regularly and prior to and after storm eventst; • All construction equipment will be properly cleaned prior to mobilizing to site; • Implement a water management plan that incorporates measures aimed at retaining site water in a pit sump and settling pond; • 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; and, • A follow-up vegetation survey will be conducted in the Spring 2018 to confirm Spiranthes species for proper identification of the potential SOCC *Spiranthes lucida* .	No significant residual effects identified. **Confidence level:** Moderate Follow up monitoring recommended. **Magnitude:** Low **Spatial Extent:** Local **Duration:** Short term (Construction and Operation) **Reversibility:** Reversible over time

Project Phase(s)	Potential Effects	Mitigation	Significance of Residual Effect(s)
Wildlife and Wildlife Habitat (refer to Section 5.6)			
Construction, Operation and Reclamation and Closure	• 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; • There is the potential for bank swallows to establish colonies in vertical banks or areas of stockpiled soils comprised of sandy material and to be directly disturbed by project activities; • Clearing and grubbing of vegetation (habitat) during construction will cause a change in immature (and limited mature) vegetation (flora) quality and/or quantity (i.e., a disturbance to wildlife habitat); • 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; • Heavy mobile equipment use during the construction or operation activities may cause direct injury or death of wildlife, through collisions or destruction of dens and food sources; • Medium and large sized mammals are unlikely to suffer direct mortality from construction 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 history cycle processes; • Following vegetation clearing, there will be local habitat fragmentation while the quarry is operational; and, • Loss of foraging habitat may occur from wetland alterations, should they be used for such purposes.	In addition to the standard mitigation measures and best management practices, the following mitigative measures will be employed: • Clearing and grubbing activities will be scheduled to the extent possible outside of the normal breeding bird and migratory bird season (April 1 to August 31). 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; • 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 Project area, a biologist will be contacted to determine whether nesting is occurring and to locate the nest. • If a nest is found within Project area, 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. • If a species at risk is encountered, contact will be made to a Species at Risk Biologist at NBDERD at (506) 453-5873 or by email.	No significant residual effects identified. **Confidence level:** Moderate Confirmatory avian surveys to be conducted in Spring and Summer 2019 to confirm the results of the desktop evaluation (in a separate supplemental report) will increase the level of confidence. **Magnitude:** Low **Spatial Extent:** Local **Duration:** Short term **Reversibility**: Reversible

Project Phase(s)	Potential Effects	Mitigation	Significance of Residual Effect(s)
Socio-Economic Environment (refer to Section 5.7)			
Construction, Operation and Reclamation and Closure	• Construction of the Project and quarrying 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 and fracturing of bedrock from blasting has the potential to damage private property; • The Project may have a negative effect on residential property values due to elevated noise levels and increased truck traffic as well as perceived effects on aesthetic value of the area; • Effects on the single home-based business (if in existence) are expected to be similar to those on residences in that vicinity; • Accidents or malfunctions associated with construction and operation of the Project have the potential to result in an increase in calls for the Upham Volunteer Fire Department, as well as other emergency response organizations; • 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; • The Project will result in the unavailability of the PDA for use for recreational hunting, trapping or gathering. During operation, approximately 30-335-405 trucks per day will added to the existing traffic on the preferred transportation route. • During operation, approximately 30-335-405 trucks per day will added to the existing traffic on the preferred transportation route; and, • The Project will generate employment for up to 10 employees or contractors.	In addition to the standard mitigation measures and best management practices, the following mitigative measures will be employed: • Hammond River Holdings is committed to engaging with local residents prior to construction of the Project to identify and consider areas of concern and find possible ways to address residents' concerns through design or mitigation; • 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 111 and the security gate will be paved; • Where possible, efforts will be made to maintain as much mature vegetation that remains along the edges of the site as possible; • 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; • Periodic pre-blast surveys will be conducted at the nearest residences, and blasts will be carefully periodically monitored using seismographs 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; • Hammond River Holdings will work with NBDTI to conduct a condition assessment of a upgrade a 9 km section of Route 111 to confirm its weight bearing capacity; • Truck drivers will adhere to posted speed limits and warning signage and adjust driving to meet weather and road conditions. • Transportation of oversized loads (very wide or heavy loads) 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.	Occasional nuisance effects to nearby residents may be possible; however, no significant residual effects were identified. **Confidence level:** High **Magnitude:** Low **Spatial Extent:** Local **Duration:** Short term (Construction and Operation) **Reversibility:** Reversible

Project Phase(s)	Potential Effects	Mitigation	Significance of Residual Effect(s)
Heritage Resources (refer to Section 5.8)			
Construction, Operation, and Reclamation and Closure	There is low potential for heritage resources to be located within the PDA. Therefore, subject to confirmation as part of the preliminary field investigation (walkover, and possible subsequent shovel test pitting), there are no potential Project-related environmental effects to heritage resources anticipated. 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.	In addition to the standard mitigation measures and best management practices, the following mitigative measures will be employed: • Planned avoidance of areas of elevated archaeological potential, to the extend practical; • Undertake an archaeological evaluation of areas proposed for ground breaking through either a field survey (walkover), to determine appropriate mitigation (e.g., shovel testing, archaeological monitoring) to identify archaeological resources that might be present; • For any areas where shovel testing is recommended following the archaeological field survey, implement this work as per the Archaeological Services (2012) Guidelines; • Implement archaeological construction monitoring for any ground breaking activities where shovel testing is not practicable; • Conduct archaeological monitoring and examination of all soil material removed from the river for any artifacts that may have been deposited in the river after eroding from the shoreline areas; and • A Project-specific Environmental Protection Plan (EPP) with defined contingency and emergency response procedures will be developed and implemented.• Work in the area must cease immediately and the Archaeological Services 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 any uncovered object; and, • Activities at the site may resume only when authorized by Archaeological Services and once mitigative measures have been completed.	No unmitigated interaction between the Project and heritage resources is expected to occur during the Project. **Confidence level:** Moderate. an AIA including walkover and shovel testing (as required) will improve the level of confidence of this prediction. **Magnitude**: Low **Spatial Extent:** Local **Duration:** Permanent **Reversibility:** Irreversible
Traditional Land and Resource Use (refer to Section 5.9)			
Construction, Operation, and Reclamation and Closure	• Upon initiating construction, access to the PDA for the purpose of carrying out traditional activities will no longer be 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; • At closure, the Project site will be reclaimed and restored to as near natural conditions as possible. As vegetation matures over the ensuing years and decades, the PDA may once again eventually harbour traditional resources of importance to Aboriginal peoples, thereby allowing a potential return of traditional land and resource use activities such as hunting, trapping, and gathering in the PDA.	• 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 First Nations throughout the Project to exchange information, address concerns, and assist in the development of management and reclamation plans for the Project; • If requested, First Nation communities or individuals will be provided with the opportunity to harvest and gather species of importance to traditional activities (timed to coincide with seasonality where possible) on the PDA prior to construction; • Reclamation of the PDA will consider traditional resources including the use of native species; • Fish and fish habitat will be monitored to ensure water flows are appropriate to mitigate bank erosion; • Affected fish habitat and wetland habitat that is lost to the Project will be authorized under federal and provincial legislation and compensated; • Wildlife and wildlife habitats within the PDA will be re-vegetated upon closure, which will partially restore habitat conditions in the PDA, over time.	No significant residual effects identified. **Confidence level:** Moderate Ongoing engagement of First Nations and a TLRU study if requested by First nationsNations, will improve the level of confidence in this prediction. **Magnitude:** Low **Spatial Extent**: Local **Duration:** Short term (Construction and Operation) **Reversibility:** Reversible over time

Project Phase(s)	Potential Effects	Mitigation	Significance of Residual Effect(s)
Accidents, Malfunctions and Unplanned Events (refer to Section 7.0)			
Pit Slope Failure	A pit 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.	• Pit 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; • Workers moving about the work site on foot will maintain a separation distance from the working areas of 1.3 times the height of the working face of the pit, unless the working face is sloped at its angle of repose or benched no more than 1.2 m (as per Section 205 of the General Regulation 91-191 under the New Brunswick Occupational Health and Safety Act); • Quarry face inspections will occur daily to ensure compliance; and; • An Emergency Response Plan will be in place as part of the Environmental Protection Plan (EPP) for the Project.	No significant residual effects anticipated. **Confidence level:** High **Magnitude:** Low to Moderate **Spatial Extent:** Local **Duration:** Short term **Reversibility**: Reversible
Failure of Erosion and Sediment Control Measures	• 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. • A failure of ESC measures could affect traditional land and resource use as a consequential environmental effect.	• 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; - 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.	No significant residual effects anticipated. **Confidence level:** High **Magnitude**: Low to Moderate **Spatial Extent:** Local **Duration:** Short term **Reversibility:** Reversible

Project Phase(s)	Potential Effects	Mitigation	Significance of Residual Effect(s)
Uncontrolled Explosion	• An uncontrolled explosion has the potential to injure or kill workers on the site, damage equipment or machinery; • 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.	• Explosives will either be transported to the Project site by a licensed blasting subcontractor on a daily basis, or stored on site in an approved and properly designed explosives magazine that meets setback and security requirements of the Explosives Act; • 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 engaged; • 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; • Periodic pre-blast surveys will be conducted at the nearest residences, and blasts will be periodically monitored using seismographs; • 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.	No significant residual effects identified. **Confidence level:** High **Magnitude:** Low to Moderate **Spatial Extent:** Local **Duration:** Short term **Reversibility:** Reversible
Vehicle Accident	• Vehicle collisions have the potential to risk human health and safety and other property such as project infrastructure or private property. • 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. • A vehicle accident could have a direct effect on wildlife in the event of vehicle-to-wildlife collision, and an indirect effect in the event of a fuel spill or fire resulting from a vehicle collision.	• The preferred transportation route was chosen to optimize safety by using roads that are designed to accommodate the vehicle weights that will be associated with the Project; • 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 111 and Route 865, 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.	No significant residual effects identified. **Confidence level:** High **Magnitude:** Low to Moderate **Spatial Extent:** Local **Duration:** Short term **Reversibility**: Reversible

Project Phase(s)	Potential Effects	Mitigation	Significance of Residual Effect(s)
Accidental Release of Hazardous Materials	• 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; • If natural resources affected by a spill are used for traditional purposes by Aboriginal persons, a consequential environmental effect of a spill could also occur to traditional land and resource use; • Effects on vegetation and wetlands 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.	• 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; • No storage of hazardous materials will occur on-site; all hazardous materials 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.	No significant residual effects anticipated. **Confidence level:** High
Discovery of a Heritage Resource	• Any ground breaking or earth moving activity has the potential to uncover previously undiscovered heritage resources.	• 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 Archaeological Services 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 any uncovered human remains. • If the discovered resources are related to Indigenous Aboriginal culture, the New Brunswick Aboriginal Affairs Secretariat will be contacted to determine how best to proceed with respect to repatriation of the resources.	No significant residual effects anticipated. **Confidence level:** Moderate An AIA including walkover and shovel testing (as required) will improve the level of confidence. **Magnitude:** Low to Moderate **Spatial Extent:** Local **Duration:** Short term **Reversibility:** Reversible

9.0 Aboriginal Consultation

The entire province of New Brunswick is currently unceded territory and is subject to the Peace and Friendship Treaties signed by the British with the Wolastoqey (Maliseet), Mi'kmaq, 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 Aboriginal peoples of Canada, and the Supreme Court of Canada has confirmed that Mi'kmaq and Wolastoqey First Nations continue to 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 First Nations, and accommodate them as necessary, for any power, duty or function they may exercise that may affect Aboriginal or treaty rights. Along with these treaty rights, First Nations maintain that they continue to hold 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 First Nations 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.

9.1 Overall Approach

The proposed Project is located within the Peace and Friendship Treaty (INAC, undated) boundaries, for which both the Wolastoqey Nation and the Mi'kmaq Nation are signatories. As such, during a meeting on September 13, 2018, the New Brunswick Aboriginal Affairs Secretariat recommended that consultation in respect of the Project be conducted with both the Wolastoqey and Mi'kmaq Nations (Mann, M., pers. comm., 2018). As such, Hammond River Holdings will initiate and seek to pursue consultation with the five member communities included in the Wolastoqey Nation in New Brunswick (WNNB) (i.e., Madawaska Maliseet First Nation, Tobique First Nation, Kingsclear First Nation, St. Mary's First Nation, and Oromocto First Nation), the Woodstock First Nation, the eight member communities of Mi'gmawe'l Tplu'taqnn Inc. (MTI) (i.e., Fort Folly First Nation, Esgenoopetitj (Burnt Church) First Nation, Indian Island First Nation, Metepenagiag (Red Bank) First Nation, Eel Ground First Nation, Buctouche First Nation, Eel River Bar First Nation, and Pabineau First Nation), and the Elsipogtog (Big Cove) First Nation.

In consultation with the Aboriginal Affairs Secretariat, the following objectives have been established to ensure meaningful consultation is carried out:

1. Consult frequently with the First Nations communities that wish to be engaged in respect of the Project in a timely manner through meaningful information updates that occur throughout the life of the Project.
2. Conduct meetings with First Nations as requested to openly discuss the potential effects of the Project, and consider appropriate mitigative measures as determined by, or in consultation with, the Aboriginal Affairs Secretariat.

To effectively consult with First Nation communities regarding the Project, consultation will be conducted as described below.

Direct Written Communication

Each First Nation community and/or organization will be initially introduced to the Project through a written introduction letter that describes the Project. The basic project description will include an overview the Project; summary of Project components and activities; description of the Project location and map; and status of the provincial regulatory approval process. In the introduction letter, Hammond River Holdings will extend an invitation for face to face meetings, via telephone or further written communications to each community to be arranged at their convenience. The intention is to provide this initial introduction letter prior to, or immediately following, registration of the Project under the EIA Regulation. Through this initial introduction, it is hoped that Hammond River Holdings will be able to clearly determine which (if any) First Nations wish to be further consulted, and in what form.

Questions, concerns, and comments from the rights holders will be recorded and responded to (as appropriate) in a timely manner.

In Person Meetings

Through the introduction letter, an invitation will be extended to each community and/or organization for an in-person meeting. It is understood that each community has a preferred method of consultation that can range from open house style meetings to focused discussions with community representatives (consultation coordinators or council members). Hammond River Holdings will afford each community the opportunity to determine which style of consultation would best suit their needs. Future meetings and other consultation activities will be defined on a case-by-case basis by each community and/or organization.

Questions, concerns and comments from the rights holders 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.hammondriverholdings.com, link available after

November 13, 2018). Should paper copies of the report be requested, they will be made available by Hammond River Holdings. Questions, comments and concerns can be submitted in writing via the Project email address (info@hammondriverholdings.com) as well as verbally to the Project hotline (506-632-4494). 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

The introduction letter (refer to **Appendix E**) was submitted to the following communities and/or organizations in mid-October 2018:

- Madawaska Maliseet First Nation (carbon copied WNNB);
- Tobique First Nation (carbon copied WNNB);
- Kingsclear First Nation (carbon copied WNNB);
- St. Mary's First Nation(carbon copied WNNB);
- Oromocto First Nation (carbon copied WNNB);
- Woodstock First Nation;
- MTI; and,
- Elsipogtog First Nation (carbon copied Kopit Lodge).

9.3 Key Issues Identification and Management

As part of the First Nations consultation 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 consultation process. An example is shown in **Table 9.3.1**.

Table 9.3.1: Sample First Nations Consultation Log

Activity	Individual or Organization	Date	Feedback, Question, Comment or Concern	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 Aboriginal 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 consultation activities will extend beyond this.

The summary report will include: type of consultation 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 9.3.1** above; and a summary of planned future consultation activities (if any). Additional mitigative measures or revisions to the Project that may arise throughout the consultation process will be flagged for further consideration by NBDELG.

10.0 Public and Stakeholder Consultation

The planned approach to public and stakeholder consultation 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.

10.1 Objectives and Overall Approach

The following objectives have been established to ensure 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, consultation will be conducted utilizing a four-pronged approach as escribed below.

<u>"Kitchen Table" Discussions</u>
Representatives from Hammond River Holdings plan to visit each residence within 2 km of the centre 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.

<u>Direct Written Notification</u>
Direct written communications describing the Project and the anticipated environmental effects and mitigation will be hand delivered to local residents and landowners within 2 km of the Project, the Hammond River Anglers Association (as a key stakeholder), other key stakeholders identified through engagement, and federal, provincial, and municipal elected officials (refer to **Appendix F**). Additionally, a basic Project description will be posted in the community newsletter and/or newspaper.

The written notification will contain the following information:

- Brief description of the Project;
- Description of the Project location and map;
- Status of the Provincial Regulatory Approval process;
- Information on how to view the EIA registration document;

- Statement indicating that members of the general public can ask questions and/or raise concerns with the Proponent regarding any and all environmental impacts;
- Contact information for Hammond River Holdings; and,
- Date that the public comment period expires.

Initial thoughts and questions from stakeholders will be recorded. Stakeholders with further questions about the Project will be invited to an open house or provided with alternate contact information.

The EIA registration document will be made available at the NBDELG Saint John Regional Office, in addition to 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.hammondriverholdings.com, link available after November 13, 2018).

Open House

One open house information session on the Project will be conducted in the local community, to provide additional project information to interested stakeholders. The open house is anticipated to occur following the submission of the EIA Registration document to the NBDELG so that environmental findings are available for discussion. 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.

In addition to having a hard copy of the EIA registration document available at the open house for viewing, the location of the electronic EIA Registration document will be provided via a link to the NBDELG website at the meeting.

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 at a later date.

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.hammondriverholdings.com, link available after November 13, 2018). Questions, comments and concerns can be submitted in writing via the Project email address (info@hammondriverholdings.com) as well as verbally to the Project hotline (506-632-4494). 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.

10.2 Engagement Activities Conducted

During the period leading up to registration of the Project, consultation has primarily focused on regulatory agencies and those involved with the project through the TRC. A meeting was held on September 13, 2018 to engage technical authorities on providing guidance on the regulatory

requirements for the Project. In addition, nearby residents were notified in advance of planned exploration activities on the Project site.

Once registration has been completed, additional engagement of the public and key stakeholders will be initiated in accordance with the approach outlined above.

10.3 Key Issues Identification and Management

As part of the Public Consultation 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 10.3.1**.

Table 10.3.1: Sample Public Consultation Log

Question	Individual or Organization	Date Received	Summary of Response	Follow Up Action

10.4 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 10.3.1** above, if comments/questions are received; and a summary of planned future consultation activities (if any) will be provided to NBDELG following the fulfillment of the public consultation requirements of the EIA process. Additional mitigative measures or revisions to the Project that may arise throughout the public consultation process will be flagged for further consideration by NBDELG.

11.0 Other Information

11.1 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 6215: Upham, NB, attached as **Appendix A**.
- Wetland delineation and functional assessment data sheets, provided in **Appendix B**.
- Field data acquired for plants and vegetation, attached as **Appendix C**.
- Desktop analysis data acquired for migratory birds, attached as **Appendix D**.
- An information package related to the Project, provided to First Nations to inform them of the Project, attached as **Appendix E**.
- An information package related to the Project which will be provided to landowners, is 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.

11.2 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.

11.3 Signature

This document is submitted on behalf of Hammond River Holdings Limited.



R. Bruce Eddy

23 Oct 2018

Date of Signature

12.0 Summary and Conclusion

This environmental impact assessment (EIA) registration document describes the planned development of, and provides an environmental effects assessment for, the Upham East Gypsum Quarry Project (the "Project") proposed by Hammond River Holdings Limited (Hammond River Holdings) in the community of Upham, Kings 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.

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 *Canadian Environmental Assessment Act, 2012* (CEAA 2012) 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 New Brunswick based wallboard manufacturing facilities. Natural gypsum, currently imported into New Brunswick from a quarry in Nova Scotia, is experiencing an increased demand due to growth in the North America wallboard industry, and this increased demand is resulting in increased costs of the raw material. The increasing cost of this raw material, as well as the elevated transportation costs tfrom Nova Scotia to New Brunswick, necessitate an economically viable source of locally-procured natural gypsum for wallboard facilities to maintain their competitiveness in the North American marketplace.

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;
- an optional truck scale, security gate, and portable trailer; and,
- an access road from the provincial Route 111 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. Eight 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, 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 Aboriginal 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 all phases 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 and design features 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.

13.0 Closing

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



Denis L. Marquis, M.Sc.E., P.Eng.
Associate, Project Manager

14.0 References

14.1 Literature Cited and Internet Sites

AC CDC (Atlantic Canada Conservation Data Centre). 2018. DATA REPORT 6215: Upham East, NB. September 2018 Data Request.

Adams J. and S. Halchuk. 2003. Fourth generation seismic hazard maps of Canada: Values for over 650 Canadian localities intended for the 2005 National Building Code of Canada. Geological Survey of Canada Open File 4459 pp. 1-155.

Archaeological Services. 2012. Guidelines and Procedures for Conducting Professional Archaeological Assessments in New Brunswick. Archaeological Services Branch, New Brunswick Department of Tourism, Heritage and Culture, Fredericton, NB.

Armstrong, T. (E.R.). 2014. Management Plan for the Bald Eagle (*Haliaeetus leucocephalus*) in Ontario. Ontario Management Plan Series. Prepared for the Ontario Ministry of Natural Resources and Forestry, Peterborough, Ontario. vii + 53 pp.

Barr. S.M. and C.E. White. 2004. *Geology of the Upham Mountain Area* (NTS 21 H/05g). Kings and Saint John counties. New Brunswick. New Brunswick Department of Natural Resources, Minerals, Policy and Planning Division. Plate 2004-116.

Barr, S.M. and C.E. White. 2005. Bedrock geology of the Loch Lomond area (NTS 21 H/05), Saint John and Kings counties, New Brunswick. New Brunswick Department of Natural Resources, Minerals, Policy and Planning Division, Plate 2005-41.

Basham, P.W. and J. Adams. 1984. The Miramichi, New Brunswick earthquakes: near surface thrust faulting in the northern Appalachians. Geoscience Canada, 11, pp. 115-121.

Boehner, R.C. 2003. *In*: Mineral Resources Branch, Report of Activities 2002, Nova Scotia Department of Natural Resources Report 2003-1, pp. 1-7.

Bradford, H., L. Robinson, and S. Doyle. 2015. Hammond River Watershed Management Plan. Hammond River Angling Association. Nauwigewauk, New Brunswick.

BSC (Bird Studies Canada). 2018. Second Atlas of the Breeding Birds of the Maritime Provinces: Species List for Square 20KR94. Available at: https://www.mba-aom.ca/jsp/datasummaries.jsp?extent=Sq&summtype=SpList&year=allyrs&atlasver=2&byextent1=Region&byextent2=Sq&region2=1&squarePC=&region1=0&square=20KR94&region3=0&species1=ALFL&lang=en. Accessed on September 17, 2018.

CCME (Canadian Council of Ministers of the Environment). 1999. Canadian water quality guidelines for the protection of aquatic life: Introduction. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

CEA Agency (Canadian Environmental Assessment Agency). 2003. Incorporating Climate Change Considerations in Environmental Assessment: General Guidance for Practitioners. Prepared by the Federal-Provincial-Territorial Committee on Climate Change and Environmental Assessment. November 2003.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2007a. COSEWIC assessment and status report on the Chimney Swift *Chaetura pelagica* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. Available at http://www.sararegistry.gc.ca/virtual_sara/files/cosewic/sr_chaetura_pelagica_e.pdf).

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2007b. COSEWIC assessment and status report on the Common Nighthawk *Chordeiles minor* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 25 pp. (www.registrelep-sararegistry.gc.ca/default_e.cfm).

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2007c. COSEWIC assessment and status report on the Olive-sided Flycatcher *Contopus cooperi* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 25 pp. Available at: https://www.sararegistry.gc.ca/document/default_e.cfm?documentID=1629. Accessed on October 5, 2018.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2008. COSEWIC assessment and status report on the Canada Warbler *Wilsonia Canadensis* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 35 pp. (www.registrelep-sararegistry.gc.ca/default_e.cfm).

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2010. COSEWIC assessment and status report on the Bobolink *Dolichonyx oryzivorus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 42 pp. (www.registrelep-sararegistry.gc.ca/default_e.cfm).

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2011. COSEWIC assessment and status report on the Barn Swallow *Hirundo rustica* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. ix + 37 pp. (www.registrelep-sararegistry.gc.ca/default_e.cfm).

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2012a. COSEWIC assessment and status report on the Eastern Wood-pewee in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. x + 39 pp. Available at: http://registrelep-sararegistry.gc.ca/document/default_e.cfm?documentID=1746. Accessed on October 5, 2018.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2012b. COSEWIC assessment and status report on the Wood Thrush *Hylocichla mustelina* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. ix + 46 pp. Available at: http://www.registrelep-sararegistry.gc.ca/document/default_e.cfm?documentID=977. Accessed on October 5, 2018.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2013. COSEWIC assessment and status report on the Bank Swallow *Riparia riparia* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. ix + 48 pp. (www.registrelep-sararegistry.gc.ca/default_e.cfm).

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2017. COSEWIC assessment and status report on the Rusty Blackbird *Euphagus carolinus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 64 pp. Available at: http://www.sararegistry.gc.ca/document/default_e.cfm?documentID=3302. Accessed on October 5, 2018.

CRI (Canadian Rivers Institute). 2011. Water Quality, In: The Saint John River: A State of the Environment Report. Fredericton, New Brunswick.

CRM Group (Cultural Resources Management Group Limited). 2018. Preliminary Investigations of a Proposed Quarry in Upham, New Brunswick.

DFO (Department of Fisheries and Oceans Canada). 2013. Fisheries Protection Policy Statement.

DFO (Department of Fisheries and Oceans Canada). 2018. Aquatic species at risk map. Accessed October, 2018. http://www.dfo-mpo.gc.ca/species-especes/sara-lep/map-carte/index-eng.html

Dillon (Dillon Consulting Limited). 2018. *Upham Gypsum Exploration – NB Online Well Log System (OWLS) Summary*, prepared for Confidential Client, NB.

ECCC (Environment and Climate Change Canada). 2017. Saint John River Floods From Top to Bottom. Available at: https://ec.gc.ca/meteo-weather/default.asp?lang=En&n=7D6FDB7C-1. Accessed on September 17, 2018.

ECCC (Environment and Climate Change Canada). 2018a. Canada's Greenhouse Gas Inventory. Available at: https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/inventory.html. Accessed on October 3, 2018.

ECCC (Environment and Climate Change Canada). 2018b. General Nesting Periods of Migratory Birds. Available at: https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/general-nesting-periods.html#_01_3 . Accessed on September 17, 2018.

ECCC (Environment and Climate Change Canada). 2018. Species at Risk Public Registry. Available online at: http://www.sararegistry.gc.ca/sar/index/default_e.cfm. Accessed August 2018.

Environment Canada. 2014. Saint John River Floods From Top to Bottom. Available at: https://ec.gc.ca/meteo-weather/default.asp?lang=En&n=7D6FDB7C-1. Accessed on September 17, 2018.

Elsipogtog First Nation. 2016. Notice of Action with Statement of Claim, Elsipogtog Mi'kmaq First Nation. Court of Queen's Bench of New Brunswick. Available at: https://www.firstpeopleslaw.com/database/files/library/STATEMENT_OF_CLAIM_(NOASOC).pdf. Accessed on September 20, 2018.

GNB (Government of New Brunswick). 2011. New Brunswick Duty to Consult Policy. Available at: https://www2.gnb.ca/content/dam/gnb/Departments/aas-saa/pdf/en/DutytoConsultPolicy.pdf. Accessed on September 20, 2018.

GNB (Government of New Brunswick) 2018a. Deer Wintering Areas. Available online: https://www2.gnb.ca/content/gnb/en/departments/erd/natural_resources/content/ForestsCrownLands/content/DeerWinteringAreas.html Accessed on: October 10, 2018.

GNB (New Brunswick Department of Tourism, Heritage and Culture). 2018b. Heritage Conservation Act Summary. Available at: Accessed: September, 2018.

GOC (Government of Canada). 2018. Canadian Climate Normals 1981-2010 Station Data. Available at: http://climate.weather.gc.ca/climate_normals/results_1981_2010_e.html?searchType=stnProv&lstProvince=NB&txtCentralLatMin=0&txtCentralLatSec=0&txtCentralLongMin=0&txtCentralLongSec=0&stnID=6250&dispBack=0. Accessed on September 20, 2018.

Goddard, I. 1996. Native languages and language families of North America. In Goddard, Ives (ed.), Handbook of North American Indians. Volume 17: Languages. Washington: Smithsonian Institute. (Map accompanying the handbook).

Health Canada. 2017. *Guidelines for Canadian Drinking Water Quality – Summary Table.* Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario. February 2017. Available online at: https://www.canada.ca/content/dam/hc-sc/migration/hc-sc/ewh-semt/alt_formats/pdf/pubs/water-eau/sum_guide-res_recom/sum_guide-res_recom-eng.pdf.

Hooper, W.C., L. McCabe, and T. Robertson. 1995. A Draft Standardized Fisheries Stream Survey for Atlantic Canada. Department of Natural Resources and Energy, Fish and Wildlife Branch.

HRAA (Hammond River Angling Association). 2015. Strategic Plan 2015-2020. Available at: https://www.hraa.ca/strategic-mgmt-plan.

HHRA (Hammond River Angling Association). 2018. About the Hammond River Angling Association. Available at: https://www.hraa.ca/. Accessed on September 27, 2018.

INAC. No date. Treaty of Peace and Friendship 1760. Indigenous and Northern Affairs Canada, Ottawa, ON. Available online at https://www.aadnc-aandc.gc.ca/eng/1100100028596/1100100028597. Accessed on September 24, 2018.

INAC (Indigenous and Northern Affairs Canada). 2018. Population of Indigenous band-members on-reserve. Available at: http://fnp-ppn.aandc-aadnc.gc.ca/fnp/Main/Search/SearchFN.aspx?lang=eng. Accessed on September 20, 2018.

IPCC (Intergovernmental Panel on Climate Change). 2014. Climate Change 2014: Synthesis Report. Available at: http://www.ipcc.ch/report/ar5/syr/. Accessed on: September 26, 2018.

McCutcheon, S.R. 1981. Stratigraphy and paleogeography of the Windsor Group in southern New Brunswick. New Brunswick Department of Natural Resources; Mineral Resources Division, Open File Report 81-31, 210 p.

NAPS (National Air Pollution Surveillance). 2018. Ambient air quality data. Available at: https://www.canada.ca/en/environment-climate-change/services/air-pollution/monitoring-networks-data.html. Accessed on September 18, 2018.

NASA (North American Space Agency). 2017. What's the Difference between Weather and Climate? Available at: https://www.nasa.gov/mission_pages/noaa-n/climate/climate_weather.html. Accessed on September 26, 2018.

Natural Resources Canada. 2018a. Earthquake Zones in Eastern Canada. Available at: http://www.seismescanada.rncan.gc.ca/zones/eastcan-en.php. Accessed on September 20, 2018.

Natural Resources Canada. 2018b. Canadian Wildland Fire Information System: Canadian Forest Fire Index (FWI) System. Available at: http://cwfis.cfs.nrcan.gc.ca/background/summary/fwi. Accessed on September 18, 2018.

Nature NB. 2018. Important Bird Areas. Available at: http://www.naturenb.ca/important-bird-areas/. Accessed on September 17, 2018.

NAV Canada. 2001. The Weather of Atlantic Canada and Eastern Quebec. Accessed at: http://www.navcanada.ca/EN/media/Publications/Local%20Area%20Weather%20Manuals/LAWM-Atlantic-EN.pdf. Accessed on September 17, 2018.

NBDELG (New Brunswick Department of Environment and Local Government). 2012. Watercourse and Wetland Alteration Technical Guidelines. Sustainable Development, Planning and Impact Evaluation Branch. Available at: http://www2.gnb.ca/content/dam/gnb/Departments/env/pdf/Water-Eau/WatercourseWetlandAlterationTechnicalGuidelines.pdf.

NBDELG (New Brunswick Department of Environment and Local Government). 2014. Rock Quarry Siting Standards. Effective August 2012, Revised August 2014. Available online at: https://www2.gnb.ca/content/dam/gnb/Departments/env/pdf/Air-Lair/RockQuarrySitingStandards.pdf. Accessed on October 15, 2018.

NBDELG (New Brunswick Department of Environment and Local Government). 2018a. A Guide to Environmental Impact Assessment in New Brunswick. Environmental Impact Assessment Branch, Fredericton, NB. Available at: https://www2.gnb.ca/content/dam/gnb/Departments/env/pdf/EIA-EIE/GuideEnvironmentalImpactAssessment.pdf. Accessed on September 20, 2018.

NBDELG (New Brunswick Department of Environment and Local Government). 2018b. Manual for Wetland Ecosystems Services Protocol for Atlantic Canada (WESP-AC): Non-tidal Wetlands. New Brunswick Dept. of Environment and Local Government, Government of New Brunswick, Fredericton, NB.

NBDELG (New Brunswick Department of Environment and Local Government). 2018b. Online Well Log System (OWLS). Available online at: https://www.elgegl.gnb.ca/0375-0001/.

NBDELG (New Brunswick Department of Environment and Local Government). 2018c. Extreme Rainfall. Available at: https://www2.gnb.ca/content/gnb/en/departments/elg/environment/content/climate_change/content/climate_change_indicators/indicators/climate/extreme_rainfall.html. Accessed on September 25, 2018.

NBDERD (New Brunswick Department of Energy and Resource Development). 2017. Wildlife Management Areas. Province of New Brunswick. Fredericton, NB.

NBDERD (New Brunswick Department of Energy and Resource Development). 2018a. General Status of Wild Species. Available at: https://www2.gnb.ca/content/gnb/en/departments/erd/natural_resources/content/wildlife/content/GeneralStatusWildSpecies.html . Accessed on September 18, 2018.

NBDERD (New Brunswick Department of Energy and Resource Development). 2018b. Fish 2018, A part of our heritage. Province of New Brunswick. Fredericton, NB.

NBDNRE-NBDELG (New Brunswick Department of Natural Resources and Energy and New Brunswick Department of Environment and Local Government). 2002. New Brunswick Wetlands Conservation Policy. Government of New Brunswick. Available online at https://www2.gnb.ca/content/dam/gnb/Departments/env/pdf/Wetlands-TerreHumides/WetlandsTerresHumides.pdf.

NBDNR (New Brunswick Department of Natural Resources). 2010. Revised NBDNR Provincial Brook Trout Assessment Program: Outline. New Brunswick Department of Natural Resources, Fish and Wildlife Branch, Fredericton, NB.

NBDOE (New Brunswick Department of Environment). 2007. New Brunswick Watersheds Fact Sheets: Hammond River. Available at: https://www2.gnb.ca/content/gnb/en/departments/elg/environment/content/water/content/watersheds.html. Accessed October 4, 2018.

NTNB (Nature Trust of New Brunswick). 2018. Wetlands: A New Brunswick Guide. The Nature Trust of New Brunswick Inc. [ISBN 978-0-9683698-6-9].

Rampton, V.N. 1984. *Surficial Geology, New Brunswick*, Geological Survey of Canada, Map 1594A, Scale 1:500 000.

St. Peter, C.J. and S.C. Johnson. 2009. Stratigraphy and structural history of the late Paleozoic Maritimes Basin in southeastern New Brunswick, Canada. New Brunswick Department of Natural Resources; Minerals, Policy and Planning Division, Memoir 3, 348 p.

Statistics Canada. 2012. Upham, New Brunswick (Code 1305004) and Canada (Code 01) (table). Census Profile. 2011 Census. Statistics Canada Catalogue no. 98-316-XWE. Ottawa. Released October 24, 2012. http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/index.cfm?Lang=E (accessed September 25, 2018).

Statistics Canada. 2017. Upham, P [Census subdivision], New Brunswick and New Brunswick [Province] (table). Census Profile. 2016 Census. Statistics Canada Catalogue no. 98-316-X2016001. Ottawa. Released November 29, 2017. https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E (accessed September 25, 2018).

USACE (United States Army Corps of Engineers). 1987. Corps of Engineers Wetlands Delineation Manual. Waterways Experiment Station Technical Report Y-87-1. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. NTIS No. AD A176 912.

USDA (United States Department of Agriculture, Natural Resources Conservation Service). 2010. Field Indicators of Hydric Soils in the United States, Version 7.0. L.M. Vasilas, G.W. Hurt, and C.V. Noble (eds.). USDA, NRCS, in cooperation with the National Technical Committee for Hydric Soils.

USDOT (United States Department of Transportation). 2018. Federal Highway Administration Roadway Construction Noise Model. Available at: https://www.fhwa.dot.gov/Environment/noise/construction_noise/rcnm.

USEPA (United States Environmental Protection Agency). 2018. AP-42 Compilation of Air Pollutant Emissions Factors. Available at: https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emissions-factors. Accessed September 26, 2018.

Wright, D.G. and G.E. Hopky. 1998. Guidelines for the use of explosives in or near Canadian fisheries waters. Can. Tech. Rep. Fish. Aquat. Sci. 2107: iv + 34p.

Zelazny, V. F. (ed.). 2007. Our landscape heritage - The story of ecological land classification in New Brunswick. New Brunswick Dept. Natural Resources. 330 pp. + appendices. Available at: https://www2.gnb.ca/content/gnb/en/departments/erd/natural_resources/content/ForestsCrownLands/content/ProtectedNaturalAreas/OurLandscapeHeritage.html. Accessed on October 12, 2018.

14.2 Personal Communications

Bear, Deborah. Member of Tobique First Nation, Tobique, NB. Personal communication following site visit. October 10, 2018.

Mann, Mary Ann. Project Executive, New Brunswick Aboriginal Affairs Secretariat, Fredericton, NB. Personal communication at meeting. September 13, 2018.

Appendix A

AC CDC Report

DATA REPORT 6215: Upham East 2, NB

Prepared 1 October 2018
by J. Churchill, Data Manager

CONTENTS OF REPORT

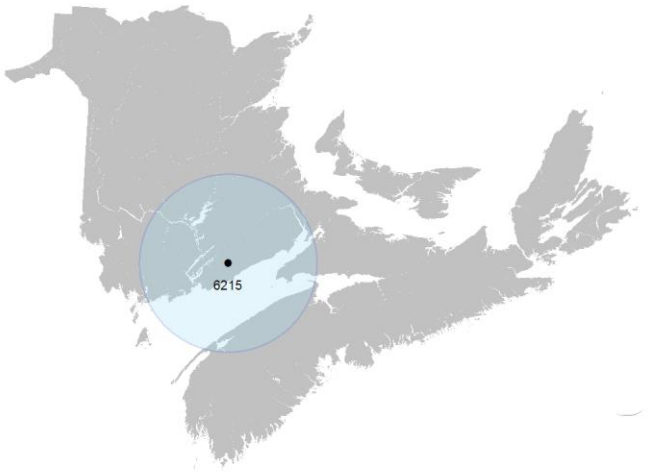
1.0 Preface
- 1.1 Data List
- 1.2 Restrictions
- 1.3 Additional Information
- Map 1: Buffered Study Area

2.0 Rare and Endangered Species
- 2.1 Flora
- 2.2 Fauna
- Map 2: Flora and Fauna

3.0 Special Areas
- 3.1 Managed Areas
- 3.2 Significant Areas
- Map 3: Special Areas

4.0 Rare Species Lists
- 4.1 Fauna
- 4.2 Flora
- 4.3 Location Sensitive Species
- 4.4 Source Bibliography

5.0 Rare Species within 100 km
- 5.1 Source Bibliography



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
Uphame2NB_6215ob.xls	All Rare and legally protected *Flora and Fauna* in your study area
Uphame2NB_6215ob100km.xls	A list of Rare and legally protected *Flora and Fauna* within 100 km of your study area
Uphame2NB_6215sa.xls	All *Significant Natural Areas* in your study area
Uphame2NB_6215ff.xls	Rare and common *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
Tel: (506) 364-2658
sean.blaney@accdc.ca

Animals (Fauna)
John Klymko, Zoologist
Tel: (506) 364-2660
john.klymko@accdc.ca

Plant Communities
Sarah Robinson, Community Ecologist
Tel: (506) 364-2664
sarah.robinson@accdc.ca

Data Management, GIS
James Churchill, Data Manager
Tel: (902) 679-6146
james.churchill@accdc.ca

Billing
Jean Breau
Tel: (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: Duncan Bayne
(902) 648-3536
Duncan.Bayne@novascotia.ca

Western: Sarah Spencer
(902) 634-7555
Sarah.Spencer@novascotia.ca

Central: Shavonne Meyer
(902) 893-6350
Shavonne.Meyer@novascotia.ca

Central: Kimberly George
(902) 890-1046
Kimberly.George@novascotia.ca

Eastern: Lisa Doucette
(902) 863-4513
Lisa.Doucette@novascotia.ca

Eastern: Terry Power
(902) 563-3370
Terrance.Power@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

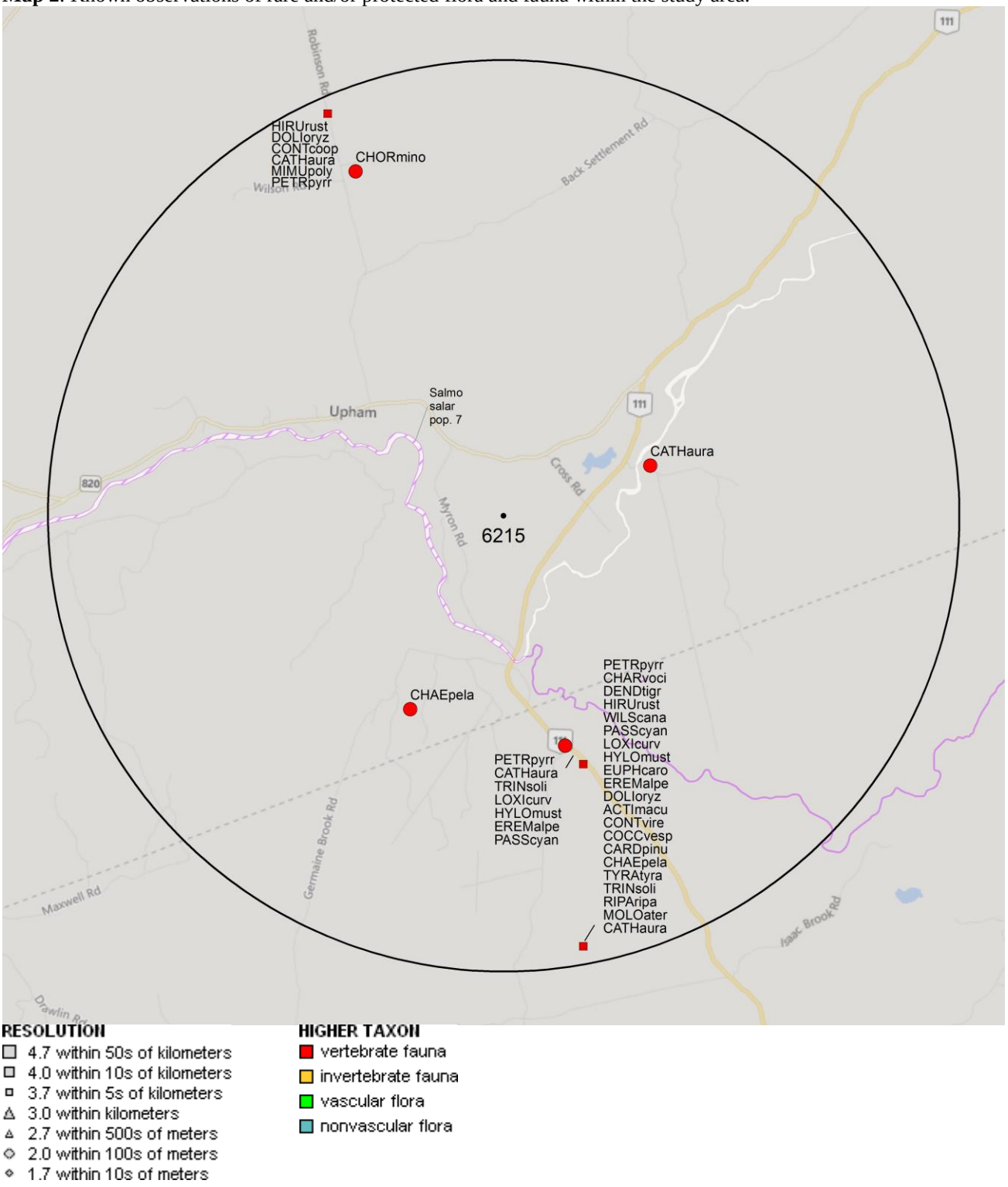
2.1 FLORA

The study area contains no records of vascular, no records of nonvascular flora (Map 2 and attached: *ob.xls).

2.2 FAUNA

The study area contains 45 records of 24 vertebrate, no records of 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

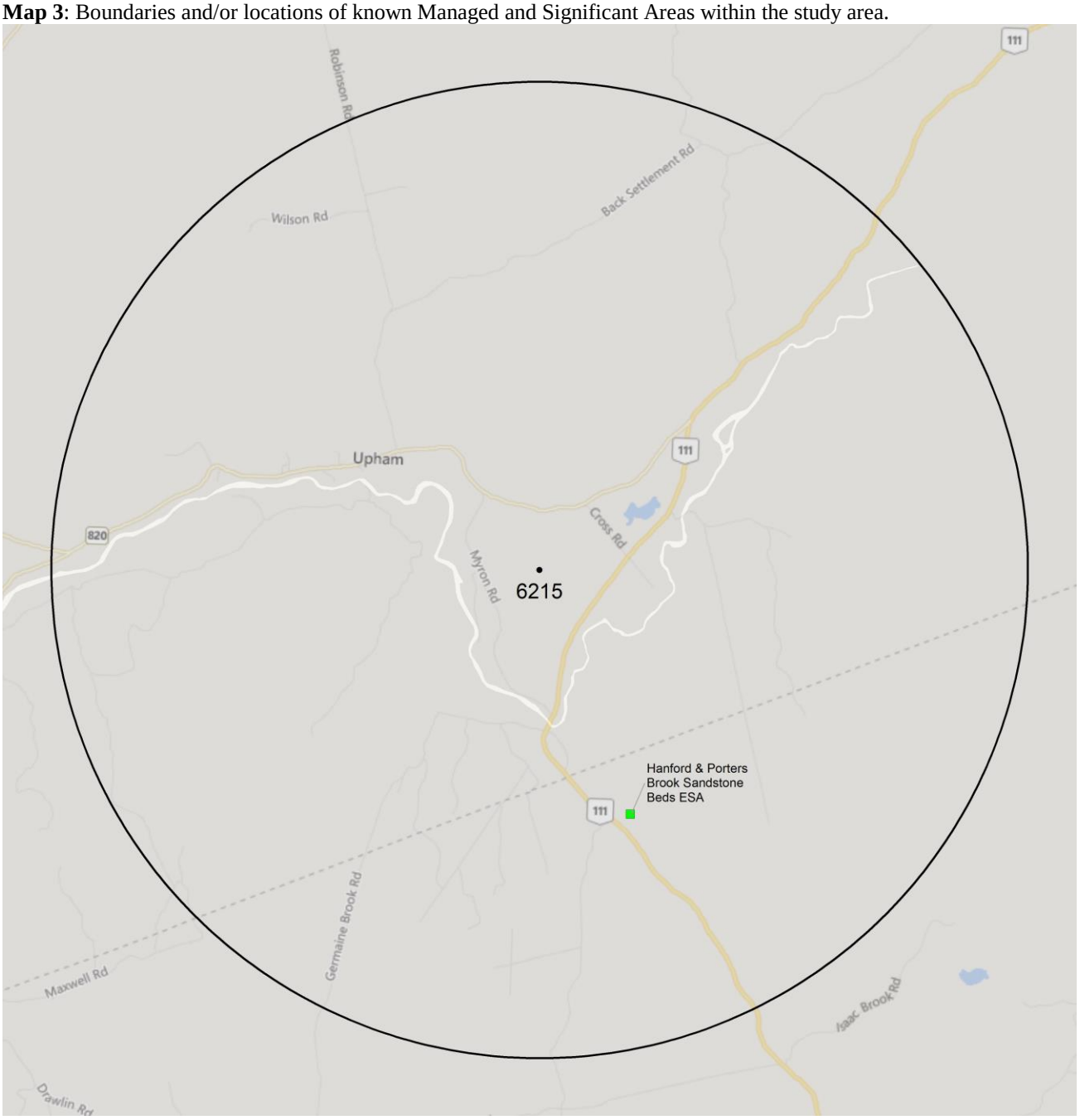
HIGHER TAXON
- vertebrate fauna
- invertebrate fauna
- vascular flora
- nonvascular flora

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 1 biologically significant site in the vicinity of the study area (Map 3 and attached file: *sa*.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	Prov GS Rank	# recs	Distance (km)

4.2 FAUNA

	Scientific *Name*	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)
A	*Hylocichla mustelina*	Wood Thrush	Threatened	Threatened	Threatened	S1S2B,S1S2M	2 May Be At Risk	2	2.9 ± 7.0
A	*Hirundo rustica*	Barn Swallow	Threatened	Threatened	Threatened	S2B,S2M	3 Sensitive	3	4.8 ± 4.0
A	*Chaetura pelagica*	Chimney Swift	Threatened	Threatened	Threatened	S2S3B,S2M	1 At Risk	2	2.4 ± 0.0
A	*Riparia riparia*	Bank Swallow	Threatened	Threatened		S2S3B,S2S3M	3 Sensitive	1	4.8 ± 7.0
A	*Wilsonia canadensis*	Canada Warbler	Threatened	Threatened	Threatened	S3B,S3M	1 At Risk	2	4.8 ± 7.0
A	*Dolichonyx oryzivorus*	Bobolink	Threatened	Threatened	Threatened	S3B,S3M	3 Sensitive	2	4.8 ± 4.0
A	*Euphagus carolinus*	Rusty Blackbird	Special Concern	Special Concern	Special Concern	S3B,S3M	2 May Be At Risk	1	4.8 ± 7.0
A	*Contopus cooperi*	Olive-sided Flycatcher	Special Concern	Threatened	Threatened	S3B,S3M	1 At Risk	1	4.8 ± 4.0
A	*Coccothraustes vespertinus*	Evening Grosbeak	Special Concern			S3B,S3S4N,SUM	3 Sensitive	1	4.8 ± 7.0
A	*Chordeiles minor*	Common Nighthawk	Special Concern	Threatened	Threatened	S3B,S4M	1 At Risk	1	4.1 ± 0.0
A	*Contopus virens*	Eastern Wood-Pewee	Special Concern	Special Concern	Special Concern	S4B,S4M	4 Secure	1	4.8 ± 7.0
A	*Eremophila alpestris*	Horned Lark				S1B,S4N,S5M	2 May Be At Risk	2	2.9 ± 7.0
A	*Mimus polyglottos*	Northern Mockingbird				S2B,S2M	3 Sensitive	1	4.8 ± 4.0
A	*Tringa solitaria*	Solitary Sandpiper				S2B,S5M	4 Secure	2	2.9 ± 7.0
A	*Petrochelidon pyrrhonota*	Cliff Swallow				S2S3B,S2S3M	3 Sensitive	4	2.6 ± 0.0
A	*Loxia curvirostra*	Red Crossbill				S3	4 Secure	2	2.9 ± 7.0
A	*Carduelis pinus*	Pine Siskin				S3	4 Secure	2	4.8 ± 7.0
A	*Cathartes aura*	Turkey Vulture				S3B,S3M	4 Secure	6	1.7 ± 0.0
A	*Charadrius vociferus*	Killdeer				S3B,S3M	3 Sensitive	2	4.8 ± 7.0
A	*Passerina cyanea*	Indigo Bunting				S3B,S3M	4 Secure	2	2.9 ± 7.0
A	*Molothrus ater*	Brown-headed Cowbird				S3B,S3M	2 May Be At Risk	1	4.8 ± 7.0
A	*Dendroica tigrina*	Cape May Warbler				S3B,S4S5M	4 Secure	1	4.8 ± 7.0
A	*Tyrannus tyrannus*	Eastern Kingbird				S3S4B,S3S4M	3 Sensitive	1	4.8 ± 7.0
A	*Actitis macularius*	Spotted Sandpiper				S3S4B,S5M	4 Secure	2	4.8 ± 7.0

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			No
Chelydra serpentina	Snapping Turtle	Special Concern	Special Concern	No
Glyptemys insculpta	Wood Turtle	Threatened	Threatened	No
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		[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.

# recs	CITATION
23	Erskine, A.J. 1992. Maritime Breeding Bird Atlas Database. NS Museum & Nimbus Publ., Halifax, 82,125 recs.
16	Lepage, D. 2014. Maritime Breeding Bird Atlas Database. Bird Studies Canada, Sackville NB, 407,838 recs.
6	eBird. 2014. eBird Basic Dataset. Version: EBD_relNov-2014. Ithaca, New York. Nov 2014. Cornell Lab of Ornithology, 25036 recs.
2	Dept of Fisheris & Oceans. 2001. Atlantic Salmon Maritime provinces overview for 2000. DFO.
1	Tims, J. & Craig, N. 1995. Environmentally Significant Areas in New Brunswick (NBESA). NB Dept of Environment & Nature Trust of New Brunswick Inc.

5.0 RARE SPECIES WITHIN 100 KM

A 100 km buffer around the study area contains 25293 records of 147 vertebrate and 1212 records of 84 invertebrate fauna; 5278 records of 334 vascular, 793 records of 193 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	Prov GS Rank	# recs	Distance (km)	Prov
A	*Myotis lucifugus*	Little Brown Myotis	Endangered	Endangered	Endangered	S1	1 At Risk	65	16.6 ± 1.0	NB
A	*Myotis septentrionalis*	Northern Long-eared Myotis	Endangered	Endangered	Endangered	S1	1 At Risk	23	18.9 ± 1.0	NB
A	*Perimyotis subflavus*	Eastern Pipistrelle	Endangered	Endangered	Endangered	S1	1 At Risk	19	11.9 ± 0.0	NB
A	*Eubalaena glacialis*	North Atlantic Right Whale	Endangered	Endangered	Endangered	S1		1	92.5 ± 50.0	NS
A	*Sterna dougallii*	Roseate Tern	Endangered	Endangered	Endangered	S1?B,S1?M	1 At Risk	2	71.9 ± 0.0	NS
A	*Charadrius melodus melodus*	Piping Plover melodus ssp	Endangered	Endangered	Endangered	S1B,S1M	1 At Risk	36	39.4 ± 0.0	NB
A	*Dermochelys coriacea (Atlantic pop.)*	Leatherback Sea Turtle - Atlantic pop.	Endangered	Endangered	Endangered	S1S2N	1 At Risk	3	38.7 ± 50.0	NB
A	*Salmo salar pop. 1*	Atlantic Salmon - Inner Bay of Fundy pop.	Endangered	Endangered	Endangered	S2	2 May Be At Risk	80	6.8 ± 50.0	NB
A	*Calidris canutus rufa*	Red Knot rufa ssp	Endangered		Endangered	S2M	1 At Risk	385	39.3 ± 0.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
A	*Rangifer tarandus pop. 2*	Woodland Caribou (Atlantic-Gasp├⌐sie pop.)	Endangered	Endangered	Extirpated	SX	0.1 Extirpated	4	20.8 ± 1.0	NB
A	*Sturnella magna*	Eastern Meadowlark	Threatened	Threatened	Threatened	S1B,S1M	2 May Be At Risk	53	8.7 ± 7.0	NB
A	*Ixobrychus exilis*	Least Bittern	Threatened	Threatened	Threatened	S1S2B,S1S2M	1 At Risk	32	25.3 ± 7.0	NB
A	*Hylocichla mustelina*	Wood Thrush	Threatened	Threatened	Threatened	S1S2B,S1S2M	2 May Be At Risk	134	2.9 ± 7.0	NB
A	*Caprimulgus vociferus*	Whip-Poor-Will	Threatened	Threatened	Threatened	S2B,S2M	1 At Risk	77	34.0 ± 7.0	NB
A	*Hirundo rustica*	Barn Swallow	Threatened	Threatened	Threatened	S2B,S2M	3 Sensitive	1101	4.8 ± 7.0	NB
A	*Catharus bicknelli*	Bicknell's Thrush	Threatened	Special Concern	Threatened	S2B,S2M	1 At Risk	10	21.4 ± 7.0	NB
A	*Glyptemys insculpta*	Wood Turtle	Threatened	Threatened	Threatened	S2S3	1 At Risk	320	16.8 ± 1.0	NB
A	*Chaetura pelagica*	Chimney Swift	Threatened	Threatened	Threatened	S2S3B,S2M	1 At Risk	424	2.4 ± 0.0	NB
A	*Riparia riparia*	Bank Swallow	Threatened	Threatened		S2S3B,S2S3M	3 Sensitive	429	4.8 ± 7.0	NB
A	*Acipenser oxyrinchus*	Atlantic Sturgeon	Threatened		Threatened	S3	4 Secure	4	65.3 ± 1.0	NB
A	*Wilsonia canadensis*	Canada Warbler	Threatened	Threatened	Threatened	S3B,S3M	1 At Risk	746	4.8 ± 7.0	NB
A	*Dolichonyx oryzivorus*	Bobolink	Threatened	Threatened	Threatened	S3B,S3M	3 Sensitive	1139	4.8 ± 7.0	NB
A	*Anguilla rostrata*	American Eel	Threatened		Threatened	S4	4 Secure	111	17.3 ± 0.0	NB
A	*Osmerus mordax pop. 2*	Lake Utopia Smelt large-bodied pop.	Threatened		Threatened			2	96.3 ± 10.0	NB
A	*Coturnicops noveboracensis*	Yellow Rail	Special Concern	Special Concern	Special Concern	S1?B,SUM	2 May Be At Risk	4	50.4 ± 7.0	NB
A	*Histrionicus histrionicus pop. 1*	Harlequin Duck - Eastern pop.	Special Concern	Special Concern	Endangered	S1B,S1S2N,S2M	1 At Risk	60	64.8 ± 4.0	NS
A	*Falco peregrinus pop. 1*	Peregrine Falcon - anatum/tundrius	Special Concern	Special Concern	Endangered	S1B,S3M	1 At Risk	475	15.1 ± 0.0	NB
A	*Asio flammeus*	Short-eared Owl	Special Concern	Special Concern	Special Concern	S2B,S2M	3 Sensitive	23	50.9 ± 0.0	NB
A	*Bucephala islandica (Eastern pop.)*	Barrow's Goldeneye - Eastern pop.	Special Concern	Special Concern	Special Concern	S2M,S2N	3 Sensitive	46	24.8 ± 0.0	NB
A	*Balaenoptera physalus*	Fin Whale - Atlantic pop.	Special Concern	Special Concern	Special Concern	S2S3		3	33.8 ± 0.0	NB
A	*Acipenser brevirostrum*	Shortnose Sturgeon	Special Concern	Special Concern	Special Concern	S3	3 Sensitive	6	20.9 ± 0.0	NB
A	*Chelydra serpentina*	Snapping Turtle	Special Concern	Special Concern	Special Concern	S3	3 Sensitive	21	13.4 ± 1.0	NB
A	*Euphagus carolinus*	Rusty Blackbird	Special Concern	Special Concern	Special Concern	S3B,S3M	2 May Be At Risk	112	4.8 ± 7.0	NB
A	*Contopus cooperi*	Olive-sided Flycatcher	Special Concern	Threatened	Threatened	S3B,S3M	1 At Risk	430	4.8 ± 4.0	NB
A	*Coccothraustes vespertinus*	Evening Grosbeak	Special Concern			S3B,S3S4N,SUM	3 Sensitive	298	4.8 ± 7.0	NB
A	*Chordeiles minor*	Common Nighthawk	Special Concern	Threatened	Threatened	S3B,S4M	1 At Risk	356	4.1 ± 0.0	NB
A	*Phalaropus lobatus*	Red-necked Phalarope	Special Concern			S3M	3 Sensitive	12	17.8 ± 0.0	NB
A	*Phocoena phocoena (NW Atlantic pop.)*	Harbour Porpoise - Northwest Atlantic pop.	Special Concern	Threatened		S4		22	38.4 ± 0.0	NB
A	*Contopus virens*	Eastern Wood-Pewee	Special Concern	Special Concern	Special Concern	S4B,S4M	4 Secure	680	4.8 ± 7.0	NB
A	*Podiceps auritus*	Horned Grebe	Special Concern		Special Concern	S4N,S4M	4 Secure	70	19.0 ± 0.0	NB
A	*Odobenus rosmarus rosmarus*	Atlantic Walrus	Special Concern		Extirpated	SX		1	81.2 ± 5.0	NS
A	*Hemidactylium scutatum*	Four-toed Salamander	Not At Risk			S1?	5 Undetermined	13	43.3 ± 0.0	NB
A	*Bubo scandiacus*	Snowy Owl	Not At Risk			S1N,S2S3M	4 Secure	13	23.5 ± 0.0	NB
A	*Accipiter cooperii*	Cooper's Hawk	Not At Risk			S1S2B,S1S2M	2 May Be At Risk	13	9.8 ± 9.0	NB
A	*Fulica americana*	American Coot	Not At Risk			S1S2B,S1S2M	3 Sensitive	32	49.8 ± 7.0	NB
A	*Aegolius funereus*	Boreal Owl	Not At Risk			S1S2B,SUM	2 May Be At Risk	2	20.9 ± 0.0	NB
A	*Sorex dispar*	Long-tailed Shrew	Not At Risk	Special Concern		S2	3 Sensitive	5	46.5 ± 1.0	NB
A	*Buteo lineatus*	Red-shouldered Hawk	Not At Risk	Special Concern		S2B,S2M	2 May Be At Risk	37	20.8 ± 0.0	NB
A	*Chlidonias niger*	Black Tern	Not At Risk			S2B,S2M	3 Sensitive	139	14.0 ± 0.0	NB
A	*Globicephala melas*	Long-finned Pilot Whale	Not At Risk			S2S3		3	22.7 ± 0.0	NB
A	*Lynx canadensis*	Canadian Lynx	Not At Risk		Endangered	S3	1 At Risk	13	23.3 ± 1.0	NB
A	*Desmognathus fuscus*	Northern Dusky Salamander	Not At Risk			S3	3 Sensitive	43	38.8 ± 1.0	NB
A	*Sterna hirundo*	Common Tern	Not At Risk			S3B,SUM	3 Sensitive	112	15.3 ± 0.0	NB
A	*Podiceps grisegena*	Red-necked Grebe	Not At Risk			S3M,S2N	3 Sensitive	51	17.1 ± 2.0	NB
A	*Lagenorhynchus acutus*	Atlantic White-sided Dolphin	Not At Risk			S3S4		2	39.4 ± 1.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
A	*Haliaeetus leucocephalus*	Bald Eagle	Not At Risk		Endangered	S4	1 At Risk	1015	1.0 ± 0.0	NB
A	*Canis lupus*	Gray Wolf	Not At Risk		Extirpated	SX	0.1 Extirpated	3	28.2 ± 1.0	NB
A	*Puma concolor pop. 1*	Eastern Cougar	Data Deficient		Endangered	SNA	5 Undetermined	110	12.0 ± 1.0	NB
A	*Morone saxatilis*	Striped Bass	E,E,SC			S3	2 May Be At Risk	38	41.2 ± 10.0	NB
A	*Salvelinus alpinus*	Arctic Char				S1	3 Sensitive	3	28.2 ± 0.0	NB
A	*Vireo flavifrons*	Yellow-throated Vireo				S1?B,S1?M	8 Accidental	17	42.1 ± 1.0	NB
A	*Tringa melanoleuca*	Greater Yellowlegs				S1?B,S5M	4 Secure	1014	15.9 ± 0.0	NB
A	*Aythya americana*	Redhead				S1B,S1M	8 Accidental	8	40.2 ± 7.0	NB
A	*Gallinula chloropus*	Common Moorhen				S1B,S1M	3 Sensitive	38	27.5 ± 7.0	NB
A	*Grus canadensis*	Sandhill Crane				S1B,S1M	8 Accidental	10	19.8 ± 7.0	NB
A	*Bartramia longicauda*	Upland Sandpiper				S1B,S1M	3 Sensitive	49	23.6 ± 0.0	NB
A	*Phalaropus tricolor*	Wilson's Phalarope				S1B,S1M	3 Sensitive	51	16.2 ± 0.0	NB
A	*Leucophaeus atricilla*	Laughing Gull				S1B,S1M	3 Sensitive	9	15.9 ± 0.0	NB
A	*Progne subis*	Purple Martin				S1B,S1M	2 May Be At Risk	213	12.8 ± 7.0	NB
A	*Thryothorus ludovicianus*	Carolina Wren				S1B,S1M	8 Accidental	14	23.2 ± 0.0	NB
A	*Oxyura jamaicensis*	Ruddy Duck				S1B,S2S3M	4 Secure	64	16.2 ± 0.0	NB
A	*Uria aalge*	Common Murre				S1B,S3N,S3M	4 Secure	7	52.0 ± 15.0	NB
A	*Aythya affinis*	Lesser Scaup				S1B,S4M	4 Secure	205	16.2 ± 0.0	NB
A	*Aythya marila*	Greater Scaup				S1B,S4M,S2N	4 Secure	34	31.2 ± 7.0	NB
A	*Eremophila alpestris*	Horned Lark				S1B,S4N,S5M	2 May Be At Risk	43	2.9 ± 7.0	NB
A	*Sterna paradisaea*	Arctic Tern				S1B,SUM	2 May Be At Risk	3	9.1 ± 0.0	NB
A	*Fratercula arctica*	Atlantic Puffin				S1B,SUN,SUM	3 Sensitive	7	52.0 ± 15.0	NB
A	*Branta bernicla*	Brant				S1N, S2S3M	4 Secure	40	19.0 ± 0.0	NB
A	*Chroicocephalus ridibundus*	Black-headed Gull				S1N,S2M	3 Sensitive	7	15.4 ± 0.0	NB
A	*Butorides virescens*	Green Heron				S1S2B,S1S2M	3 Sensitive	17	38.0 ± 0.0	NB
A	*Nycticorax nycticorax*	Black-crowned Night-heron				S1S2B,S1S2M	3 Sensitive	8	38.3 ± 1.0	NB
A	*Empidonax traillii*	Willow Flycatcher				S1S2B,S1S2M	3 Sensitive	106	10.5 ± 7.0	NB
A	*Stelgidopteryx serripennis*	Northern Rough-winged Swallow				S1S2B,S1S2M	2 May Be At Risk	11	50.4 ± 7.0	NB
A	*Troglodytes aedon*	House Wren				S1S2B,S1S2M	5 Undetermined	20	16.9 ± 0.0	NB
A	*Rissa tridactyla*	Black-legged Kittiwake				S1S2B,S4N,S5M	4 Secure	2	82.6 ± 7.0	NB
A	*Calidris bairdii*	Baird's Sandpiper				S1S2M	3 Sensitive	54	39.3 ± 0.0	NB
A	*Cistothorus palustris*	Marsh Wren				S2B,S2M	3 Sensitive	113	27.8 ± 0.0	NB
A	*Mimus polyglottos*	Northern Mockingbird				S2B,S2M	3 Sensitive	145	4.8 ± 4.0	NB
A	*Toxostoma rufum*	Brown Thrasher				S2B,S2M	3 Sensitive	61	25.3 ± 7.0	NB
A	*Pooecetes gramineus*	Vesper Sparrow				S2B,S2M	2 May Be At Risk	91	9.8 ± 5.0	NB
A	*Anas strepera*	Gadwall				S2B,S3M	4 Secure	132	16.2 ± 0.0	NB
A	*Alca torda*	Razorbill				S2B,S3N,S3M	4 Secure	4	52.0 ± 15.0	NB
A	*Pinicola enucleator*	Pine Grosbeak				S2B,S4S5N,S4S5M	3 Sensitive	29	44.0 ± 7.0	NB
A	*Tringa solitaria*	Solitary Sandpiper				S2B,S5M	4 Secure	172	2.9 ± 7.0	NB
A	*Oceanodroma leucorhoa*	Leach's Storm-Petrel				S2B,SUM	3 Sensitive	4	54.9 ± 0.0	NB
A	*Chen caerulescens*	Snow Goose				S2M	4 Secure	6	19.0 ± 0.0	NB
A	*Phalacrocorax carbo*	Great Cormorant				S2N,S2M	4 Secure	30	19.0 ± 0.0	NB
A	*Somateria spectabilis*	King Eider				S2N,S2M	4 Secure	5	19.0 ± 0.0	NB
A	*Larus hyperboreus*	Glaucous Gull				S2N,S2M	4 Secure	129	15.8 ± 6.0	NB
A	*Asio otus*	Long-eared Owl				S2S3	5 Undetermined	17	39.9 ± 7.0	NB
A	*Picoides dorsalis*	American Three-toed Woodpecker				S2S3	3 Sensitive	12	43.2 ± 0.0	NB
A	*Salmo salar*	Atlantic Salmon				S2S3	2 May Be At Risk	41	22.8 ± 0.0	NB
A	*Anas clypeata*	Northern Shoveler				S2S3B,S2S3M	4 Secure	247	10.5 ± 7.0	NB
A	*Myiarchus crinitus*	Great Crested Flycatcher				S2S3B,S2S3M	3 Sensitive	224	10.5 ± 7.0	NB
A	*Petrochelidon pyrrhonota*	Cliff Swallow				S2S3B,S2S3M	3 Sensitive	500	2.6 ± 0.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
A	*Pluvialis dominica*	American Golden-Plover				S2S3M	3 Sensitive	125	17.8 ± 0.0	NB
A	*Calcarius lapponicus*	Lapland Longspur				S2S3N,SUM	3 Sensitive	21	16.3 ± 0.0	NB
A	*Cepphus grylle*	Black Guillemot				S3	4 Secure	82	18.3 ± 7.0	NB
A	*Loxia curvirostra*	Red Crossbill				S3	4 Secure	148	2.9 ± 7.0	NB
A	*Carduelis pinus*	Pine Siskin				S3	4 Secure	358	4.8 ± 7.0	NB
A	*Prosopium cylindraceum*	Round Whitefish				S3	4 Secure	1	71.8 ± 0.0	NB
A	*Salvelinus namaycush*	Lake Trout				S3	3 Sensitive	3	57.7 ± 0.0	NB
A	*Sorex maritimensis*	Maritime Shrew				S3	4 Secure	1	78.6 ± 0.0	NS
A	*Eptesicus fuscus*	Big Brown Bat				S3	3 Sensitive	39	27.8 ± 1.0	NB
A	*Cathartes aura*	Turkey Vulture				S3B,S3M	4 Secure	272	1.7 ± 0.0	NB
A	*Rallus limicola*	Virginia Rail				S3B,S3M	3 Sensitive	156	10.5 ± 7.0	NB
A	*Charadrius vociferus*	Killdeer				S3B,S3M	3 Sensitive	761	4.8 ± 7.0	NB
A	*Tringa semipalmata*	Willet				S3B,S3M	3 Sensitive	67	17.8 ± 0.0	NB
A	*Coccyzus erythropthalmus*	Black-billed Cuckoo				S3B,S3M	4 Secure	162	5.3 ± 7.0	NB
A	*Vireo gilvus*	Warbling Vireo				S3B,S3M	4 Secure	227	16.9 ± 0.0	NB
A	*Piranga olivacea*	Scarlet Tanager				S3B,S3M	4 Secure	114	10.3 ± 7.0	NB
A	*Passerina cyanea*	Indigo Bunting				S3B,S3M	4 Secure	71	2.9 ± 7.0	NB
A	*Molothrus ater*	Brown-headed Cowbird				S3B,S3M	2 May Be At Risk	301	4.8 ± 7.0	NB
A	*Icterus galbula*	Baltimore Oriole				S3B,S3M	4 Secure	216	10.5 ± 7.0	NB
A	*Somateria mollissima*	Common Eider				S3B,S4M,S3N	4 Secure	408	11.9 ± 7.0	NB
A	*Dendroica tigrina*	Cape May Warbler				S3B,S4S5M	4 Secure	138	4.8 ± 7.0	NB
A	*Anas acuta*	Northern Pintail				S3B,S5M	3 Sensitive	83	15.8 ± 0.0	NB
A	*Mergus serrator*	Red-breasted Merganser				S3B,S5M,S4S5N	4 Secure	70	11.9 ± 5.0	NB
A	*Arenaria interpres*	Ruddy Turnstone				S3M	4 Secure	373	17.8 ± 0.0	NB
A	*Phalaropus fulicarius*	Red Phalarope				S3M	3 Sensitive	4	52.2 ± 11.0	NB
A	*Melanitta nigra*	Black Scoter				S3M,S1S2N	3 Sensitive	199	15.8 ± 8.0	NB
A	*Bucephala albeola*	Bufflehead				S3M,S2N	3 Sensitive	558	16.2 ± 0.0	NB
A	*Calidris maritima*	Purple Sandpiper				S3M,S3N	4 Secure	149	15.8 ± 6.0	NB
A	*Uria lomvia*	Thick-billed Murre				S3N,S3M	5 Undetermined	5	52.0 ± 15.0	NB
A	*Synaptomys cooperi*	Southern Bog Lemming				S3S4	4 Secure	95	16.6 ± 1.0	NB
A	*Tyrannus tyrannus*	Eastern Kingbird				S3S4B,S3S4M	3 Sensitive	529	4.8 ± 7.0	NB
A	*Actitis macularius*	Spotted Sandpiper				S3S4B,S5M	4 Secure	740	4.8 ± 7.0	NB
A	*Gallinago delicata*	Wilson's Snipe				S3S4B,S5M	4 Secure	748	5.3 ± 7.0	NB
A	*Larus delawarensis*	Ring-billed Gull				S3S4B,S5M	4 Secure	194	9.8 ± 5.0	NB
A	*Dendroica striata*	Blackpoll Warbler				S3S4B,S5M	4 Secure	42	5.2 ± 0.0	NB
A	*Pluvialis squatarola*	Black-bellied Plover				S3S4M	4 Secure	1148	17.8 ± 0.0	NB
A	*Limosa haemastica*	Hudsonian Godwit				S3S4M	4 Secure	100	47.7 ± 0.0	NB
A	*Calidris pusilla*	Semipalmated Sandpiper				S3S4M	4 Secure	1716	15.9 ± 0.0	NB
A	*Calidris melanotos*	Pectoral Sandpiper				S3S4M	4 Secure	226	15.9 ± 0.0	NB
A	*Calidris alba*	Sanderling				S3S4M,S1N	3 Sensitive	1106	17.1 ± 2.0	NB
A	*Morus bassanus*	Northern Gannet				SHB,S5M	4 Secure	57	19.0 ± 0.0	NB
A	*Lanius ludovicianus*	Loggerhead Shrike				SXB,SXM	1 At Risk	1	96.4 ± 0.0	NB
C	*Quercus macrocarpa - Acer rubrum / Onoclea sensibilis - Carex arcta Forest*	Bur Oak - Red Maple / Sensitive Fern - Northern Clustered Sedge Forest				S2		1	61.4 ± 0.0	NB
C	*Acer saccharinum / Onoclea sensibilis - Lysimachia terrestris Forest*	Silver Maple / Sensitive Fern - Swamp Yellow Loosestrife Forest				S3		1	77.0 ± 0.0	NB
C	*Acer saccharum - Fraxinus americana / Polystichum acrostichoides Forest*	Sugar Maple - White Ash / Christmas Fern Forest				S3S4		1	19.3 ± 0.0	NB
I	*Cicindela*	Cobblestone Tiger Beetle	Endangered	Endangered	Endangered	S1	1 At Risk	42	59.7 ± 0.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
	marginipennis									
I	*Gomphus ventricosus*	Skillet Clubtail	Endangered		Endangered	S1S2	2 May Be At Risk	50	49.8 ± 0.0	NB
I	*Danaus plexippus*	Monarch	Endangered	Special Concern	Special Concern	S3B,S3M	3 Sensitive	123	14.7 ± 5.0	NB
I	*Ophiogomphus howei*	Pygmy Snaketail	Special Concern	Special Concern	Special Concern	S2	2 May Be At Risk	14	85.2 ± 0.0	NB
I	*Alasmidonta varicosa*	Brook Floater	Special Concern		Special Concern	S2	3 Sensitive	10	64.0 ± 1.0	NB
I	*Lampsilis cariosa*	Yellow Lampmussel	Special Concern	Special Concern	Special Concern	S2	3 Sensitive	96	31.4 ± 0.0	NB
I	*Bombus terricola*	Yellow-banded Bumblebee	Special Concern			S3?	3 Sensitive	27	19.7 ± 0.0	NB
I	*Appalachina sayana*	Spike-lip Crater	Not At Risk			S3?		2	34.1 ± 1.0	NB
I	*Haematopota rara*	Shy Cleg				S1	5 Undetermined	1	95.9 ± 1.0	NB
I	*Erora laeta*	Early Hairstreak				S1	2 May Be At Risk	2	92.9 ± 1.0	NS
I	*Arigomphus furcifer*	Lilypad Clubtail				S1	5 Undetermined	6	53.4 ± 0.0	NB
I	*Polites origenes*	Crossline Skipper				S1?	5 Undetermined	4	45.4 ± 0.0	NB
I	*Plebejus saepiolus*	Greenish Blue				S1S2	4 Secure	5	62.1 ± 1.0	NB
I	*Ophiogomphus colubrinus*	Boreal Snaketail				S1S2	2 May Be At Risk	34	63.1 ± 0.0	NB
I	*Brachyleptura circumdata*	a Longhorned Beetle				S2		6	67.8 ± 0.0	NB
I	*Satyrium calanus falacer*	Banded Hairstreak				S2	4 Secure	17	81.7 ± 1.0	NS
I	*Strymon melinus*	Grey Hairstreak				S2	4 Secure	5	62.5 ± 0.0	NB
I	*Aeshna clepsydra*	Mottled Darner				S2	3 Sensitive	8	31.7 ± 0.0	NB
I	*Somatochlora brevicincta*	Quebec Emerald				S2	5 Undetermined	1	96.8 ± 0.0	NB
I	*Somatochlora tenebrosa*	Clamp-Tipped Emerald				S2	5 Undetermined	3	93.6 ± 1.0	NB
I	*Ladona exusta*	White Corporal				S2	5 Undetermined	3	77.7 ± 0.0	NB
I	*Ischnura posita*	Fragile Forktail				S2	2 May Be At Risk	10	75.6 ± 1.0	NS
I	*Callophrys henrici*	Henry's Elfin				S2S3	4 Secure	22	89.2 ± 7.0	NB
I	*Celithemis martha*	Martha's Pennant				S2S3	5 Undetermined	4	52.7 ± 0.0	NB
I	*Sphaeroderus nitidicollis*	a Ground Beetle				S3	4 Secure	1	67.9 ± 0.0	NB
I	*Lepturopsis biforis*	a Longhorned Beetle				S3		1	40.2 ± 1.0	NB
I	*Orthosoma brunneum*	a Longhorned Beetle				S3		1	61.5 ± 5.0	NB
I	*Elaphrus americanus*	a Ground Beetle				S3	4 Secure	2	72.3 ± 0.0	NB
I	*Desmocerus palliatus*	Elderberry Borer				S3		4	40.2 ± 1.0	NB
I	*Agonum crenistriatum*	a Ground Beetle				S3	5 Undetermined	1	96.1 ± 1.0	NB
I	*Agonum consimile*	a Ground Beetle				S3	4 Secure	1	96.1 ± 1.0	NB
I	*Agonum excavatum*	a Ground Beetle				S3	4 Secure	1	77.2 ± 0.0	NB
I	*Clivina americana*	a Ground Beetle				S3	4 Secure	1	77.2 ± 0.0	NB
I	*Lachnocrepis parallela*	a Ground Beetle				S3	4 Secure	1	79.8 ± 0.0	NB
I	*Dyschirius setosus*	a Ground Beetle				S3	5 Undetermined	3	79.8 ± 0.0	NB
I	*Harpalus fulvilabris*	a Ground Beetle				S3	4 Secure	1	73.2 ± 0.0	NB
I	*Olisthopus parmatus*	a Ground Beetle				S3	4 Secure	1	67.9 ± 0.0	NB
I	*Paratachys scitulus*	a Ground Beetle				S3	5 Undetermined	1	77.2 ± 0.0	NB
I	*Amara pallipes*	a Ground Beetle				S3	4 Secure	2	79.5 ± 0.0	NB
I	*Carabus maeander*	a Ground Beetle				S3	5 Undetermined	1	96.1 ± 1.0	NB
I	*Carabus serratus*	a Ground Beetle				S3	4 Secure	1	90.5 ± 1.0	NB
I	*Coccinella hieroglyphica kirbyi*	a Ladybird Beetle				S3	4 Secure	1	40.2 ± 1.0	NB
I	*Hippodamia parenthesis*	Parenthesis Lady Beetle				S3	4 Secure	7	40.2 ± 1.0	NB
I	*Stenocorus vittigera*	a Longhorned Beetle				S3		1	77.2 ± 0.0	NB
I	*Gnathacmaeops pratensis*	a Longhorned Beetle				S3		5	40.2 ± 1.0	NB
I	*Pogonocherus mixtus*	a Longhorned Beetle				S3		1	40.2 ± 1.0	NB
I	*Badister neopulchellus*	a Ground Beetle				S3	4 Secure	1	77.2 ± 0.0	NB
I	*Calathus gregarius*	a Ground Beetle				S3	4 Secure	1	48.6 ± 1.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
I	*Gonioctena americana*	a Leaf Beetle				S3		1	79.5 ± 0.0	NB
I	*Saperda lateralis*	a Longhorned Beetle				S3		2	51.0 ± 0.0	NB
I	*Trachysida aspera*	a Longhorned Beetle				S3		1	67.6 ± 0.0	NB
I	*Hesperia sassacus*	Indian Skipper				S3	4 Secure	4	89.2 ± 7.0	NB
I	*Euphyes bimacula*	Two-spotted Skipper				S3	4 Secure	11	81.2 ± 1.0	NB
I	*Lycaena hyllus*	Bronze Copper				S3	3 Sensitive	35	42.8 ± 0.0	NB
I	*Satyrium acadica*	Acadian Hairstreak				S3	4 Secure	22	27.5 ± 7.0	NB
I	*Callophrys polios*	Hoary Elfin				S3	4 Secure	21	40.1 ± 1.0	NB
I	*Plebejus idas empetri*	Crowberry Blue				S3	4 Secure	25	47.0 ± 1.0	NB
I	*Speyeria aphrodite*	Aphrodite Fritillary				S3	4 Secure	32	40.1 ± 1.0	NB
I	*Boloria bellona*	Meadow Fritillary				S3	4 Secure	36	42.8 ± 0.0	NB
I	*Boloria chariclea grandis*	Purple Lesser Fritillary				S3	4 Secure	8	98.7 ± 1.0	NB
I	*Polygonia satyrus*	Satyr Comma				S3	4 Secure	12	52.5 ± 1.0	NB
I	*Polygonia gracilis*	Hoary Comma				S3	4 Secure	4	53.0 ± 7.0	NB
I	*Nymphalis l-album*	Compton Tortoiseshell				S3	4 Secure	20	14.7 ± 5.0	NB
I	*Gomphus vastus*	Cobra Clubtail				S3	3 Sensitive	58	33.2 ± 0.0	NB
I	*Gomphus abbreviatus*	Spine-crowned Clubtail				S3	4 Secure	25	24.8 ± 0.0	NB
I	*Gomphaeschna furcillata*	Harlequin Darner				S3	5 Undetermined	4	93.6 ± 1.0	NB
I	*Dorocordulia lepida*	Petite Emerald				S3	4 Secure	26	38.4 ± 0.0	NB
I	*Somatochlora cingulata*	Lake Emerald				S3	4 Secure	6	38.4 ± 0.0	NB
I	*Somatochlora forcipata*	Forcipate Emerald				S3	4 Secure	6	48.6 ± 1.0	NB
I	*Williamsonia fletcheri*	Ebony Boghaunter				S3	4 Secure	10	60.8 ± 0.0	NB
I	*Lestes eurinus*	Amber-Winged Spreadwing				S3	4 Secure	3	56.8 ± 1.0	NB
I	*Lestes vigilax*	Swamp Spreadwing				S3	3 Sensitive	20	38.4 ± 0.0	NB
I	*Enallagma geminatum*	Skimming Bluet				S3	5 Undetermined	13	49.2 ± 0.0	NB
I	*Enallagma signatum*	Orange Bluet				S3	4 Secure	10	53.7 ± 0.0	NB
I	*Stylurus scudderi*	Zebra Clubtail				S3	4 Secure	73	24.8 ± 0.0	NB
I	*Alasmidonta undulata*	Triangle Floater				S3	3 Sensitive	50	14.7 ± 0.0	NB
I	*Leptodea ochracea*	Tidewater Mucket				S3	4 Secure	57	25.0 ± 0.0	NB
I	*Striatura ferrea*	Black Striate				S3		1	94.9 ± 1.0	NB
I	*Neohelix albolabris*	Whitelip				S3		2	30.4 ± 0.0	NB
I	*Spurwinkia salsa*	Saltmarsh Hydrobe				S3		32	23.9 ± 0.0	NB
I	*Pantala hymenaea*	Spot-Winged Glider				S3B,S3M	4 Secure	3	53.1 ± 1.0	NB
I	*Satyrium liparops strigosum*	Striped Hairstreak				S3S4	4 Secure	18	89.1 ± 0.0	NB
I	*Cupido comyntas*	Eastern Tailed Blue				S3S4	4 Secure	4	29.0 ± 5.0	NB
I	*Coccinella transversoguttata richardsoni*	Transverse Lady Beetle				SH	2 May Be At Risk	21	40.2 ± 1.0	NB
N	*Erioderma mollissimum*	Graceful Felt Lichen	Endangered		Endangered	SH	2 May Be At Risk	1	46.0 ± 1.0	NB
N	*Erioderma pedicellatum (Atlantic pop.)*	Boreal Felt Lichen - Atlantic pop.	Endangered	Endangered	Endangered	SH	1 At Risk	2	57.3 ± 0.0	NS
N	*Peltigera hydrothyria*	Eastern Waterfan	Threatened			S1	5 Undetermined	6	44.4 ± 1.0	NB
N	*Anzia colpodes*	Black-foam Lichen	Threatened			S1S2	5 Undetermined	2	49.5 ± 1.0	NB
N	*Degelia plumbea*	BluDegelia plumbeae Felt Lichen	Special Concern	Special Concern	Special Concern	S1	2 May Be At Risk	2	57.2 ± 0.0	NS
N	*Pseudevernia cladonia*	Ghost Antler Lichen	Not At Risk			S2S3	5 Undetermined	18	26.1 ± 0.0	NB
N	*Aloina rigida*	Aloe-Like Rigid Screw Moss				S1	2 May Be At Risk	1	92.2 ± 0.0	NB
N	*Bryum muehlenbeckii*	Muehlenbeck's Bryum Moss				S1	2 May Be At Risk	1	44.7 ± 1.0	NB
N	*Dicranoweisia crispula*	Mountain Thatch Moss				S1	2 May Be At Risk	1	53.0 ± 0.0	NB
N	*Didymodon rigidulus var. gracilis*	a moss				S1	2 May Be At Risk	1	48.9 ± 1.0	NB
N	*Sphagnum macrophyllum*	Sphagnum				S1	2 May Be At Risk	2	56.6 ± 0.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
N	*Syntrichia ruralis*	a Moss				S1	2 May Be At Risk	1	29.4 ± 0.0	NB
N	*Coscinodon cribrosus*	Sieve-Toothed Moss				S1	2 May Be At Risk	1	43.0 ± 0.0	NB
N	*Cladonia metacorallifera*	Reptilian Pixie-cup Lichen				S1	5 Undetermined	5	42.0 ± 1.0	NB
N	*Coccocarpia palmicola*	Salted Shell Lichen				S1	2 May Be At Risk	1	56.0 ± 1.0	NB
N	*Peltigera collina*	Tree Pelt Lichen				S1	2 May Be At Risk	1	80.8 ± 0.0	NS
N	*Peltigera malacea*	Veinless Pelt Lichen				S1	5 Undetermined	1	44.5 ± 1.0	NB
N	*Bryoria bicolor*	Electrified Horsehair Lichen				S1	2 May Be At Risk	1	44.5 ± 1.0	NB
N	*Hygrobiella laxifolia*	Lax Notchwort				S1?	6 Not Assessed	1	42.1 ± 1.0	NB
N	*Bartramia ithyphylla*	Straight-leaved Apple Moss				S1?	2 May Be At Risk	2	42.1 ± 0.0	NB
N	*Calliergon trifarium*	Three-ranked Moss				S1?	2 May Be At Risk	1	51.2 ± 0.0	NB
N	*Dichelyma falcatum*	a Moss				S1?	2 May Be At Risk	2	53.4 ± 1.0	NB
N	*Dicranum bonjeanii*	Bonjean's Broom Moss				S1?	2 May Be At Risk	2	93.4 ± 0.0	NS
N	*Dicranum condensatum*	Condensed Broom Moss				S1?	2 May Be At Risk	2	52.8 ± 0.0	NB
N	*Entodon brevisetus*	a Moss				S1?	2 May Be At Risk	1	63.6 ± 10.0	NB
N	*Eurhynchium hians*	Light Beaked Moss				S1?	2 May Be At Risk	3	25.2 ± 0.0	NB
N	*Homomallium adnatum*	Adnate Hairy-gray Moss				S1?	2 May Be At Risk	3	63.6 ± 10.0	NB
N	*Plagiothecium latebricola*	Alder Silk Moss				S1?	2 May Be At Risk	2	48.0 ± 0.0	NB
N	*Rhytidium rugosum*	Wrinkle-leaved Moss				S1?	2 May Be At Risk	2	26.1 ± 0.0	NB
N	*Seligeria recurvata*	a Moss				S1?	2 May Be At Risk	3	71.7 ± 1.0	NB
N	*Splachnum pennsylvanicum*	Southern Dung Moss				S1?	2 May Be At Risk	1	82.0 ± 1.0	NB
N	*Cephaloziella spinigera*	Spiny Threadwort				S1S2	6 Not Assessed	2	85.1 ± 0.0	NB
N	*Cladopodiella francisci*	Holt's Notchwort				S1S2	6 Not Assessed	4	48.9 ± 1.0	NB
N	*Harpanthus flotovianus*	Great Mountain Flapwort				S1S2	6 Not Assessed	2	43.4 ± 1.0	NB
N	*Jungermannia obovata*	Egg Flapwort				S1S2	6 Not Assessed	2	31.5 ± 0.0	NB
N	*Pallavicinia lyellii*	Lyell's Ribbonwort				S1S2	6 Not Assessed	2	36.0 ± 1.0	NB
N	*Radula tenax*	Tenacious Scalewort				S1S2	6 Not Assessed	1	53.4 ± 0.0	NB
N	*Brachythecium acuminatum*	Acuminate Ragged Moss				S1S2	5 Undetermined	6	46.0 ± 100.0	NB
N	*Bryum salinum*	a Moss				S1S2	2 May Be At Risk	2	48.8 ± 1.0	NB
N	*Campylium radicale*	Long-stalked Fine Wet Moss				S1S2	5 Undetermined	2	91.2 ± 3.0	NS
N	*Tortula obtusifolia*	a Moss				S1S2	2 May Be At Risk	1	16.1 ± 0.0	NB
N	*Distichium inclinatum*	Inclined Iris Moss				S1S2	2 May Be At Risk	5	48.7 ± 0.0	NB
N	*Ditrichum pallidum*	Pale Cow-hair Moss				S1S2	2 May Be At Risk	2	45.6 ± 1.0	NB
N	*Drummondia prorepens*	a Moss				S1S2	2 May Be At Risk	1	91.8 ± 0.0	NS
N	*Hygrohypnum bestii*	Best's Brook Moss				S1S2	3 Sensitive	5	33.5 ± 0.0	NB
N	*Timmia norvegica*	a moss				S1S2	2 May Be At Risk	3	15.4 ± 0.0	NB
N	*Timmia norvegica var. excurrens*	a moss				S1S2	2 May Be At Risk	1	48.7 ± 0.0	NB
N	*Tomentypnum falcifolium*	Sickle-leaved Golden Moss				S1S2	2 May Be At Risk	1	71.4 ± 1.0	NB
N	*Tortella humilis*	Small Crisp Moss				S1S2	2 May Be At Risk	7	42.4 ± 0.0	NB
N	*Pseudotaxiphyllum distichaceum*	a Moss				S1S2	2 May Be At Risk	3	80.1 ± 1.0	NB
N	*Hamatocaulis vernicosus*	a Moss				S1S2	2 May Be At Risk	1	19.3 ± 100.0	NB
N	*Bryohaplocladium microphyllum*	Tiny-leaved Haplocladium Moss				S1S2	2 May Be At Risk	1	69.1 ± 3.0	NS
N	*Umbilicaria vellea*	Grizzled Rocktripe Lichen				S1S2	5 Undetermined	1	48.8 ± 1.0	NB
N	*Peltigera scabrosa*	Greater Toad Pelt Lichen				S1S2	2 May Be At Risk	4	53.2 ± 1.0	NB
N	*Calypogeia neesiana*	Nees' Pouchwort				S1S3	6 Not Assessed	1	19.7 ± 1.0	NB
N	*Cephaloziella elachista*	Spurred Threadwort				S1S3	6 Not Assessed	1	51.3 ± 5.0	NB
N	*Porella pinnata*	Pinnate Scalewort				S1S3	6 Not Assessed	1	18.5 ± 1.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
N	*Tritomaria scitula*	Mountain Notchwort				S1S3	6 Not Assessed	1	55.6 ± 1.0	NB
N	*Amphidium mougeotii*	a Moss				S2	3 Sensitive	12	42.1 ± 0.0	NB
N	*Anomodon viticulosus*	a Moss				S2	2 May Be At Risk	6	20.5 ± 0.0	NB
N	*Cirriphyllum piliferum*	Hair-pointed Moss				S2	3 Sensitive	4	28.0 ± 0.0	NB
N	*Dicranella palustris*	Drooping-Leaved Fork Moss				S2	3 Sensitive	10	23.6 ± 100.0	NB
N	*Didymodon ferrugineus*	a moss				S2	3 Sensitive	2	20.1 ± 1.0	NB
N	*Anomodon tristis*	a Moss				S2	2 May Be At Risk	8	48.7 ± 10.0	NB
N	*Hypnum pratense*	Meadow Plait Moss				S2	3 Sensitive	2	48.0 ± 0.0	NB
N	*Isopterygiopsis pulchella*	Neat Silk Moss				S2	3 Sensitive	8	48.1 ± 0.0	NB
N	*Meesia triquetra*	Three-ranked Cold Moss				S2	2 May Be At Risk	1	46.0 ± 100.0	NB
N	*Physcomitrium immersum*	a Moss				S2	3 Sensitive	6	18.5 ± 1.0	NB
N	*Platydictya jungermannioides*	False Willow Moss				S2	3 Sensitive	4	43.6 ± 0.0	NB
N	*Pohlia elongata*	Long-necked Nodding Moss				S2	3 Sensitive	10	42.4 ± 0.0	NB
N	*Seligeria calcarea*	Chalk Brittle Moss				S2	3 Sensitive	2	53.2 ± 0.0	NB
N	*Sphagnum centrale*	Central Peat Moss				S2	3 Sensitive	8	42.4 ± 0.0	NB
N	*Sphagnum lindbergii*	Lindberg's Peat Moss				S2	3 Sensitive	8	17.8 ± 5.0	NB
N	*Sphagnum flexuosum*	Flexuous Peatmoss				S2	3 Sensitive	2	50.1 ± 0.0	NB
N	*Tayloria serrata*	Serrate Trumpet Moss				S2	3 Sensitive	8	20.2 ± 1.0	NB
N	*Tetrodontium brownianum*	Little Georgia				S2	3 Sensitive	7	48.2 ± 1.0	NB
N	*Tetraplodon mnioides*	Entire-leaved Nitrogen Moss				S2	3 Sensitive	3	73.6 ± 0.0	NB
N	*Thamnobryum alleghaniense*	a Moss				S2	3 Sensitive	13	15.1 ± 0.0	NB
N	*Tortula mucronifolia*	Mucronate Screw Moss				S2	3 Sensitive	1	43.0 ± 0.0	NB
N	*Ulota phyllantha*	a Moss				S2	3 Sensitive	5	48.4 ± 1.0	NB
N	*Anomobryum filiforme*	a moss				S2	5 Undetermined	5	17.0 ± 0.0	NB
N	*Cladonia macrophylla*	Fig-leaved Lichen				S2	5 Undetermined	3	51.3 ± 1.0	NB
N	*Fuscopannaria leucosticta*	Rimmed Shingles Lichen				S2	2 May Be At Risk	5	17.7 ± 0.0	NB
N	*Leptogium corticola*	Blistered Jellyskin Lichen				S2	2 May Be At Risk	1	74.4 ± 0.0	NB
N	*Nephroma laevigatum*	Mustard Kidney Lichen				S2	2 May Be At Risk	2	70.2 ± 0.0	NS
N	*Andreaea rothii*	a Moss				S2?	3 Sensitive	6	27.7 ± 0.0	NB
N	*Anomodon minor*	Blunt-leaved Anomodon Moss				S2?	2 May Be At Risk	1	64.5 ± 1.0	NB
N	*Brachythecium digastrum*	a Moss				S2?	3 Sensitive	2	51.4 ± 0.0	NB
N	*Bryum pallescens*	Pale Bryum Moss				S2?	5 Undetermined	2	42.4 ± 1.0	NB
N	*Dichelyma capillaceum*	Hairlike Dichelyma Moss				S2?	3 Sensitive	1	64.1 ± 3.0	NB
N	*Dicranum spurium*	Spurred Broom Moss				S2?	3 Sensitive	1	66.1 ± 0.0	NB
N	*Hygrohypnum montanum*	a Moss				S2?	3 Sensitive	2	26.3 ± 1.0	NB
N	*Schistostega pennata*	Luminous Moss				S2?	3 Sensitive	3	23.6 ± 100.0	NB
N	*Seligeria campylopoda*	a Moss				S2?	3 Sensitive	1	19.3 ± 100.0	NB
N	*Seligeria diversifolia*	a Moss				S2?	3 Sensitive	2	17.0 ± 0.0	NB
N	*Sphagnum angermanicum*	a Peatmoss				S2?	3 Sensitive	3	67.3 ± 10.0	NB
N	*Trichodon cylindricus*	Cylindric Hairy-teeth Moss				S2?	3 Sensitive	3	71.7 ± 10.0	NB
N	*Plagiomnium rostratum*	Long-beaked Leafy Moss				S2?	3 Sensitive	7	15.0 ± 0.0	NB
N	*Ramalina pollinaria*	Chalky Ramalina Lichen				S2?	5 Undetermined	1	51.8 ± 1.0	NB
N	*Nephroma arcticum*	Arctic Kidney Lichen				S2?	3 Sensitive	1	45.1 ± 1.0	NB
N	*Bryum uliginosum*	a Moss				S2S3	3 Sensitive	2	23.1 ± 4.0	NB
N	*Buxbaumia aphylla*	Brown Shield Moss				S2S3	3 Sensitive	4	91.2 ± 3.0	NS
N	*Calliergonella cuspidata*	Common Large Wetland Moss				S2S3	3 Sensitive	8	32.1 ± 0.0	NB
N	*Campylium polygamum*	a Moss				S2S3	3 Sensitive	1	45.1 ± 0.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
N	*Palustriella falcata*	a Moss				S2S3	3 Sensitive	2	42.1 ± 0.0	NB
N	*Didymodon rigidulus*	Rigid Screw Moss				S2S3	3 Sensitive	8	48.7 ± 0.0	NB
N	*Ephemerum serratum*	a Moss				S2S3	3 Sensitive	4	28.9 ± 0.0	NB
N	*Orthotrichum speciosum*	Showy Bristle Moss				S2S3	5 Undetermined	2	85.4 ± 1.0	NS
N	*Pohlia proligera*	Cottony Nodding Moss				S2S3	3 Sensitive	5	48.4 ± 1.0	NB
N	*Racomitrium fasciculare*	a Moss				S2S3	3 Sensitive	3	42.1 ± 0.0	NB
N	*Racomitrium affine*	a Moss				S2S3	3 Sensitive	1	52.6 ± 1.0	NB
N	*Saelania glaucescens*	Blue Dew Moss				S2S3	3 Sensitive	2	53.0 ± 0.0	NB
N	*Scorpidium scorpioides*	Hooked Scorpion Moss				S2S3	3 Sensitive	4	32.1 ± 0.0	NB
N	*Sphagnum subfulvum*	a Peatmoss				S2S3	2 May Be At Risk	3	71.4 ± 1.0	NB
N	*Taxiphyllum deplanatum*	Imbricate Yew-leaved Moss				S2S3	3 Sensitive	3	52.9 ± 1.0	NB
N	*Zygodon viridissimus*	a Moss				S2S3	2 May Be At Risk	3	52.9 ± 1.0	NB
N	*Schistidium agassizii*	Elf Bloom Moss				S2S3	3 Sensitive	3	42.2 ± 0.0	NB
N	*Loeskeobryum brevirostre*	a Moss				S2S3	3 Sensitive	15	34.2 ± 2.0	NB
N	*Cyrtomnium hymenophylloides*	Short-pointed Lantern Moss				S2S3	3 Sensitive	6	42.1 ± 0.0	NB
N	*Cladonia acuminata*	Scantily Clad Pixie Lichen				S2S3	5 Undetermined	2	46.0 ± 1.0	NB
N	*Cladonia ramulosa*	Bran Lichen				S2S3	5 Undetermined	4	49.5 ± 1.0	NB
N	*Cladonia sulphurina*	Greater Sulphur-cup Lichen				S2S3	5 Undetermined	1	57.9 ± 1.0	NB
N	*Parmeliopsis ambigua*	Green Starburst Lichen				S2S3	5 Undetermined	1	43.5 ± 1.0	NB
N	*Sphaerophorus globosus*	Northern Coral Lichen				S2S3	3 Sensitive	5	42.2 ± 1.0	NB
N	*Cynodontium tenellum*	Delicate Dogtooth Moss				S3	3 Sensitive	1	80.1 ± 1.0	NB
N	*Hypnum curvifolium*	Curved-leaved Plait Moss				S3	3 Sensitive	19	42.1 ± 0.0	NB
N	*Tortella fragilis*	Fragile Twisted Moss				S3	3 Sensitive	1	48.7 ± 0.0	NB
N	*Schistidium maritimum*	a Moss				S3	4 Secure	6	48.4 ± 1.0	NB
N	*Hymenostylium recurvirostre*	Hymenostylium Moss				S3	3 Sensitive	4	48.4 ± 1.0	NB
N	*Collema nigrescens*	Blistered Tarpaper Lichen				S3	3 Sensitive	1	98.6 ± 0.0	NS
N	*Solorina saccata*	Woodland Owl Lichen				S3	5 Undetermined	6	43.5 ± 1.0	NB
N	*Normandina pulchella*	Rimmed Elf-ear Lichen				S3	5 Undetermined	4	44.7 ± 1.0	NB
N	*Cladonia farinacea*	Farinose Pixie Lichen				S3	5 Undetermined	5	51.3 ± 1.0	NB
N	*Cladonia strepsilis*	Olive Cladonia Lichen				S3	4 Secure	1	19.6 ± 0.0	NB
N	*Leptogium lichenoides*	Tattered Jellyskin Lichen				S3	5 Undetermined	6	48.8 ± 1.0	NB
N	*Nephroma bellum*	Naked Kidney Lichen				S3	4 Secure	3	43.8 ± 1.0	NB
N	*Peltigera degenii*	Lustrous Pelt Lichen				S3	5 Undetermined	3	44.4 ± 1.0	NB
N	*Usnea strigosa*	Bushy Beard Lichen				S3	5 Undetermined	2	54.6 ± 1.0	NB
N	*Leptogium laceroides*	Short-bearded Jellyskin Lichen				S3	3 Sensitive	2	49.9 ± 1.0	NB
N	*Peltigera membranacea*	Membranous Pelt Lichen				S3	5 Undetermined	6	43.5 ± 1.0	NB
N	*Cladonia carneola*	Crowned Pixie-cup Lichen				S3	5 Undetermined	1	51.3 ± 1.0	NB
N	*Cladonia deformis*	Lesser Sulphur-cup Lichen				S3	4 Secure	5	42.0 ± 1.0	NB
N	*Aulacomnium androgynum*	Little Groove Moss				S3?	4 Secure	8	48.4 ± 1.0	NB
N	*Bryum amblyodon*	a Moss				S3?	4 Secure	1	96.0 ± 3.0	NS
N	*Dicranella rufescens*	Red Forklet Moss				S3?	5 Undetermined	3	48.7 ± 0.0	NB
N	*Rhytidiadelphus loreus*	Lanky Moss				S3?	2 May Be At Risk	1	48.9 ± 1.0	NB
N	*Sphagnum lescurii*	a Peatmoss				S3?	5 Undetermined	5	26.3 ± 1.0	NB
N	*Stereocaulon subcoralloides*	Coralloid Foam Lichen				S3?	5 Undetermined	1	51.8 ± 1.0	NB
N	*Anomodon rugelii*	Rugel's Anomodon Moss				S3S4	3 Sensitive	2	70.7 ± 1.0	NS
N	*Barbula convoluta*	Lesser Bird's-claw Beard Moss				S3S4	4 Secure	1	97.5 ± 15.0	NB
N	*Brachythecium*	Velvet Ragged Moss				S3S4	4 Secure	7	43.5 ± 1.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
	velutinum									
N	*Calliergon giganteum*	Giant Spear Moss				S3S4	3 Sensitive	1	91.2 ± 3.0	NS
N	*Dicranella cerviculata*	a Moss				S3S4	3 Sensitive	5	48.0 ± 2.0	NB
N	*Dicranella varia*	a Moss				S3S4	4 Secure	1	76.6 ± 3.0	NS
N	*Dicranum majus*	Greater Broom Moss				S3S4	4 Secure	18	47.3 ± 0.0	NB
N	*Dicranum leioneuron*	a Dicranum Moss				S3S4	4 Secure	1	47.4 ± 0.0	NB
N	*Encalypta ciliata*	Fringed Extinquisher Moss				S3S4	3 Sensitive	2	49.0 ± 0.0	NB
N	*Fissidens bryoides*	Lesser Pocket Moss				S3S4	4 Secure	3	20.8 ± 5.0	NB
N	*Helodium blandowii*	Wetland-plume Moss				S3S4	4 Secure	1	94.5 ± 3.0	NS
N	*Heterocladium dimorphum*	Dimorphous Tangle Moss				S3S4	4 Secure	4	52.2 ± 0.0	NB
N	*Isopterygiopsis muelleriana*	a Moss				S3S4	4 Secure	18	48.1 ± 0.0	NB
N	*Myurella julacea*	Small Mouse-tail Moss				S3S4	4 Secure	2	48.3 ± 0.0	NB
N	*Physcomitrium pyriforme*	Pear-shaped Urn Moss				S3S4	3 Sensitive	5	27.8 ± 0.0	NB
N	*Pogonatum dentatum*	Mountain Hair Moss				S3S4	4 Secure	4	48.5 ± 0.0	NB
N	*Sphagnum quinquefarium*	Five-ranked Peat Moss				S3S4	4 Secure	1	47.6 ± 0.0	NB
N	*Sphagnum torreyanum*	a Peatmoss				S3S4	4 Secure	5	29.9 ± 0.0	NB
N	*Sphagnum austinii*	Austin's Peat Moss				S3S4	4 Secure	1	56.3 ± 1.0	NB
N	*Sphagnum contortum*	Twisted Peat Moss				S3S4	4 Secure	1	32.1 ± 0.0	NB
N	*Splachnum rubrum*	Red Collar Moss				S3S4	4 Secure	1	26.1 ± 1.0	NB
N	*Tetraphis geniculata*	Geniculate Four-tooth Moss				S3S4	4 Secure	16	45.8 ± 3.0	NB
N	*Tetraplodon angustatus*	Toothed-leaved Nitrogen Moss				S3S4	4 Secure	3	27.2 ± 0.0	NB
N	*Weissia controversa*	Green-Cushioned Weissia				S3S4	4 Secure	2	48.4 ± 1.0	NB
N	*Abietinella abietina*	Wiry Fern Moss				S3S4	4 Secure	1	48.7 ± 0.0	NB
N	*Trichostomum tenuirostre*	Acid-Soil Moss				S3S4	4 Secure	5	42.1 ± 0.0	NB
N	*Pannaria rubiginosa*	Brown-eyed Shingle Lichen				S3S4	3 Sensitive	2	47.6 ± 1.0	NB
N	*Ramalina thrausta*	Angelhair Ramalina Lichen				S3S4	5 Undetermined	11	42.0 ± 1.0	NB
N	*Hypogymnia vittata*	Slender Monk's Hood Lichen				S3S4	4 Secure	22	42.2 ± 1.0	NB
N	*Cladonia floerkeana*	Gritty British Soldiers Lichen				S3S4	4 Secure	5	19.6 ± 0.0	NB
N	*Hypocenomyce friesii*	a Lichen				S3S4	5 Undetermined	1	48.8 ± 1.0	NB
N	*Melanelia panniformis*	Shingled Camouflage Lichen				S3S4	5 Undetermined	4	44.5 ± 1.0	NB
N	*Nephroma parile*	Powdery Kidney Lichen				S3S4	4 Secure	9	16.3 ± 0.0	NB
N	*Protopannaria pezizoides*	Brown-gray Moss-shingle Lichen				S3S4	4 Secure	14	25.4 ± 0.0	NB
N	*Pseudocyphellaria perpetua*	Gilded Specklebelly Lichen				S3S4	3 Sensitive	46	42.4 ± 0.0	NB
N	*Pannaria conoplea*	Mealy-rimmed Shingle Lichen				S3S4	3 Sensitive	2	57.9 ± 0.0	NS
N	*Anaptychia palmulata*	Shaggy Fringed Lichen				S3S4	3 Sensitive	19	50.0 ± 1.0	NB
N	*Peltigera neopolydactyla*	Undulating Pelt Lichen				S3S4	5 Undetermined	8	43.5 ± 1.0	NB
N	*Cladonia cariosa*	Lesser Ribbed Pixie Lichen				S3S4	4 Secure	3	53.3 ± 1.0	NB
N	*Hypocenomyce scalaris*	Common Clam Lichen				S3S4	5 Undetermined	1	51.8 ± 1.0	NB
N	*Dermatocarpon luridum*	Brookside Stippleback Lichen				S3S4	4 Secure	15	16.3 ± 0.0	NB
N	*Grimmia anodon*	Toothless Grimmia Moss				SH	5 Undetermined	2	40.7 ± 10.0	NB
N	*Leucodon brachypus*	a Moss				SH	2 May Be At Risk	9	50.7 ± 0.0	NB
N	*Thelia hirtella*	a Moss				SH	2 May Be At Risk	1	46.0 ± 100.0	NB
N	*Cyrto-hypnum minutulum*	Tiny Cedar Moss				SH	2 May Be At Risk	3	61.5 ± 10.0	NB
P	*Juglans cinerea*	Butternut	Endangered	Endangered	Endangered	S1	1 At Risk	35	17.7 ± 1.0	NB
P	*Polemonium*	Van Brunt's Jacob's-ladder	Threatened	Threatened	Threatened	S1	1 At Risk	72	75.5 ± 0.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
	vanbruntiae									
P	*Isoetes prototypus*	Prototype Quillwort	Special Concern	Special Concern	Endangered	S2	1 At Risk	6	50.2 ± 0.0	NB
P	*Cryptotaenia canadensis*	Canada Honewort				S1	2 May Be At Risk	1	29.2 ± 1.0	NB
P	*Sanicula trifoliata*	Large-Fruited Sanicle				S1	2 May Be At Risk	1	17.4 ± 5.0	NB
P	*Antennaria parlinii*	a Pussytoes				S1	2 May Be At Risk	5	43.2 ± 1.0	NB
P	*Antennaria howellii ssp. petaloidea*	Pussy-Toes				S1	2 May Be At Risk	2	42.4 ± 5.0	NB
P	*Bidens discoidea*	Swamp Beggarticks				S1	2 May Be At Risk	3	67.9 ± 0.0	NB
P	*Pseudognaphalium obtusifolium*	Eastern Cudweed				S1	2 May Be At Risk	8	68.0 ± 1.0	NB
P	*Hieracium kalmii*	Kalm's Hawkweed				S1	2 May Be At Risk	3	67.6 ± 1.0	NB
P	*Hieracium kalmii var. kalmii*	Kalm's Hawkweed				S1	2 May Be At Risk	4	68.4 ± 1.0	NB
P	*Hieracium paniculatum*	Panicled Hawkweed				S1	2 May Be At Risk	17	27.8 ± 0.0	NB
P	*Hieracium robinsonii*	Robinson's Hawkweed				S1	3 Sensitive	9	42.2 ± 0.0	NB
P	*Solidago multiradiata*	Multi-rayed Goldenrod				S1	2 May Be At Risk	19	83.6 ± 0.0	NB
P	*Cynoglossum virginianum var. boreale*	Wild Comfrey				S1	2 May Be At Risk	2	98.4 ± 0.0	NS
P	*Cardamine parviflora var. arenicola*	Small-flowered Bittercress				S1	2 May Be At Risk	8	29.6 ± 0.0	NB
P	*Draba arabisans*	Rock Whitlow-Grass				S1	2 May Be At Risk	23	18.3 ± 1.0	NB
P	*Draba glabella*	Rock Whitlow-Grass				S1	2 May Be At Risk	13	32.0 ± 0.0	NB
P	*Minuartia groenlandica*	Greenland Stitchwort				S1	2 May Be At Risk	1	58.3 ± 0.0	NB
P	*Chenopodium capitatum*	Strawberry-blite				S1	2 May Be At Risk	4	15.4 ± 1.0	NB
P	*Chenopodium simplex*	Maple-leaved Goosefoot				S1	2 May Be At Risk	9	30.7 ± 1.0	NB
P	*Suaeda rolandii*	Roland's Sea-Blite				S1	3 Sensitive	3	55.0 ± 0.0	NB
P	*Triadenum virginicum*	Virginia St John's-wort				S1	2 May Be At Risk	2	42.0 ± 0.0	NB
P	*Corema conradii*	Broom Crowberry				S1	2 May Be At Risk	7	42.7 ± 10.0	NB
P	*Vaccinium boreale*	Northern Blueberry				S1	2 May Be At Risk	2	62.8 ± 0.0	NS
P	*Desmodium glutinosum*	Large Tick-Trefoil				S1	2 May Be At Risk	16	80.6 ± 0.0	NS
P	*Lespedeza capitata*	Round-headed Bush-clover				S1	2 May Be At Risk	8	57.6 ± 0.0	NB
P	*Gentiana rubricaulis*	Purple-stemmed Gentian				S1	2 May Be At Risk	1	89.6 ± 0.0	NB
P	*Proserpinaca pectinata*	Comb-leaved Mermaidweed				S1	2 May Be At Risk	2	79.4 ± 0.0	NB
P	*Pycnanthemum virginianum*	Virginia Mountain Mint				S1	2 May Be At Risk	4	27.8 ± 0.0	NB
P	*Lysimachia quadrifolia*	Whorled Yellow Loosestrife				S1	2 May Be At Risk	14	24.7 ± 0.0	NB
P	*Primula laurentiana*	Laurentian Primrose				S1	2 May Be At Risk	37	47.8 ± 0.0	NB
P	*Ranunculus sceleratus*	Cursed Buttercup				S1	2 May Be At Risk	4	47.5 ± 0.0	NB
P	*Amelanchier fernaldii*	Fernald's Serviceberry				S1	2 May Be At Risk	1	78.8 ± 1.0	NB
P	*Crataegus jonesiae*	Jones' Hawthorn				S1	2 May Be At Risk	4	91.8 ± 1.0	NB
P	*Dryas integrifolia*	Entire-leaved Mountain Avens				S1	2 May Be At Risk	14	85.2 ± 0.0	NB
P	*Potentilla canadensis*	Canada Cinquefoil				S1	5 Undetermined	1	78.9 ± 0.0	NB
P	*Salix myrtillifolia*	Blueberry Willow				S1	2 May Be At Risk	24	85.7 ± 0.0	NB
P	*Saxifraga paniculata ssp. neogaea*	White Mountain Saxifrage				S1	2 May Be At Risk	34	24.0 ± 0.0	NB
P	*Agalinis paupercula var. borealis*	Small-flowered Agalinis				S1	2 May Be At Risk	7	21.4 ± 1.0	NB
P	*Agalinis tenuifolia*	Slender Agalinis				S1	2 May Be At Risk	6	89.4 ± 0.0	NB
P	*Gratiola aurea*	Golden Hedge-Hyssop				S1	3 Sensitive	2	57.1 ± 0.0	NB
P	*Pedicularis canadensis*	Canada Lousewort				S1	2 May Be At Risk	1	97.4 ± 0.0	NB
P	*Viola sagittata var. ovata*	Arrow-Leaved Violet				S1	2 May Be At Risk	31	69.4 ± 2.0	NS
P	*Alisma subcordatum*	Southern Water Plantain				S1	5 Undetermined	2	18.3 ± 0.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
P	*Carex atlantica ssp. atlantica*	Atlantic Sedge				S1	2 May Be At Risk	4	29.7 ± 0.0	NB
P	*Carex backii*	Rocky Mountain Sedge				S1	2 May Be At Risk	3	28.5 ± 0.0	NB
P	*Carex merritt-fernaldii*	Merritt Fernald's Sedge				S1	2 May Be At Risk	1	60.8 ± 0.0	NB
P	*Carex saxatilis*	Russet Sedge				S1	2 May Be At Risk	13	25.3 ± 10.0	NB
P	*Carex scirpoidea*	Scirpuslike Sedge				S1	2 May Be At Risk	6	24.1 ± 0.0	NB
P	*Carex sterilis*	Sterile Sedge				S1	2 May Be At Risk	1	66.1 ± 2.0	NB
P	*Carex grisea*	Inflated Narrow-leaved Sedge				S1	2 May Be At Risk	9	25.7 ± 0.0	NB
P	*Cyperus diandrus*	Low Flatsedge				S1	2 May Be At Risk	4	89.4 ± 1.0	NB
P	*Cyperus lupulinus*	Hop Flatsedge				S1	2 May Be At Risk	6	61.1 ± 0.0	NB
P	*Cyperus lupulinus ssp. macilentus*	Hop Flatsedge				S1	2 May Be At Risk	16	55.8 ± 0.0	NB
P	*Scirpus pendulus*	Hanging Bulrush				S1	2 May Be At Risk	5	60.6 ± 0.0	NB
P	*Sisyrinchium angustifolium*	Narrow-leaved Blue-eyed-grass				S1	2 May Be At Risk	13	42.6 ± 1.0	NB
P	*Juncus greenei*	Greene's Rush				S1	2 May Be At Risk	1	90.3 ± 0.0	NB
P	*Juncus subtilis*	Creeping Rush				S1	2 May Be At Risk	1	43.8 ± 5.0	NB
P	*Allium canadense*	Canada Garlic				S1	2 May Be At Risk	1	28.3 ± 0.0	NB
P	*Goodyera pubescens*	Downy Rattlesnake-Plantain				S1	2 May Be At Risk	7	39.5 ± 0.0	NB
P	*Malaxis brachypoda*	White Adder's-Mouth				S1	2 May Be At Risk	2	56.3 ± 0.0	NS
P	*Platanthera flava var. herbiola*	Pale Green Orchid				S1	2 May Be At Risk	26	76.5 ± 1.0	NS
P	*Platanthera macrophylla*	Large Round-Leaved Orchid				S1	2 May Be At Risk	2	25.7 ± 1.0	NB
P	*Bromus pubescens*	Hairy Wood Brome Grass				S1	5 Undetermined	6	61.3 ± 0.0	NB
P	*Cinna arundinacea*	Sweet Wood Reed Grass				S1	2 May Be At Risk	6	26.1 ± 0.0	NB
P	*Danthonia compressa*	Flattened Oat Grass				S1	2 May Be At Risk	17	28.7 ± 1.0	NB
P	*Dichanthelium dichotomum*	Forked Panic Grass				S1	2 May Be At Risk	1	26.8 ± 1.0	NB
P	*Festuca subverticillata*	Nodding Fescue				S1	2 May Be At Risk	2	58.5 ± 1.0	NS
P	*Glyceria obtusa*	Atlantic Manna Grass				S1	2 May Be At Risk	2	79.1 ± 0.0	NB
P	*Potamogeton friesii*	Fries' Pondweed				S1	2 May Be At Risk	8	47.1 ± 5.0	NB
P	*Potamogeton nodosus*	Long-leaved Pondweed				S1	2 May Be At Risk	4	77.1 ± 5.0	NB
P	*Potamogeton strictifolius*	Straight-leaved Pondweed				S1	2 May Be At Risk	2	17.4 ± 2.0	NB
P	*Xyris difformis*	Bog Yellow-eyed-grass				S1	5 Undetermined	3	42.1 ± 0.0	NB
P	*Asplenium ruta-muraria var. cryptolepis*	Wallrue Spleenwort				S1	2 May Be At Risk	3	31.6 ± 0.0	NB
P	*Cystopteris laurentiana*	Laurentian Bladder Fern				S1	2 May Be At Risk	1	25.7 ± 1.0	NB
P	*Dryopteris filix-mas*	Male Fern				S1	2 May Be At Risk	2	73.1 ± 1.0	NB
P	*Botrychium oneidense*	Blunt-lobed Moonwort				S1	2 May Be At Risk	4	73.5 ± 5.0	NB
P	*Schizaea pusilla*	Little Curlygrass Fern				S1	2 May Be At Risk	25	26.2 ± 0.0	NB
P	*Hieracium kalmii var. fasciculatum*	Kalm's Hawkweed				S1?	5 Undetermined	1	93.1 ± 1.0	NB
P	*Cuscuta campestris*	Field Dodder				S1?	2 May Be At Risk	3	56.0 ± 5.0	NB
P	*Carex laxiflora*	Loose-Flowered Sedge				S1?	5 Undetermined	3	55.8 ± 7.0	NS
P	*Wolffia columbiana*	Columbian Watermeal				S1?	2 May Be At Risk	5	70.9 ± 0.0	NB
P	*Rumex aquaticus var. fenestratus*	Western Dock				S1S2	2 May Be At Risk	1	93.2 ± 1.0	NB
P	*Potamogeton bicupulatus*	Snailseed Pondweed				S1S2	2 May Be At Risk	5	63.5 ± 0.0	NB
P	*Selaginella rupestris*	Rock Spikemoss				S1S2	2 May Be At Risk	8	25.9 ± 1.0	NB
P	*Thelypteris simulata*	Bog Fern				S1S2	2 May Be At Risk	7	60.0 ± 0.0	NB
P	*Cuscuta cephalanthi*	Buttonbush Dodder				S1S3	2 May Be At Risk	2	33.0 ± 0.0	NB
P	*Listera australis*	Southern Twayblade			Endangered	S2	1 At Risk	13	75.5 ± 0.0	NB
P	*Osmorhiza longistylis*	Smooth Sweet Cicely				S2	3 Sensitive	2	91.0 ± 1.0	NS
P	*Sanicula odorata*	Clustered Sanicle				S2	2 May Be At Risk	4	91.1 ± 2.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
P	*Pseudognaphalium macounii*	Macoun's Cudweed				S2	3 Sensitive	3	43.0 ± 0.0	NB
P	*Symphyotrichum racemosum*	Small White Aster				S2	3 Sensitive	8	16.3 ± 0.0	NB
P	*Impatiens pallida*	Pale Jewelweed				S2	2 May Be At Risk	6	24.5 ± 0.0	NB
P	*Alnus serrulata*	Smooth Alder				S2	3 Sensitive	8	46.5 ± 0.0	NB
P	*Arabis drummondii*	Drummond's Rockcress				S2	3 Sensitive	19	18.3 ± 0.0	NB
P	*Sagina nodosa*	Knotted Pearlwort				S2	3 Sensitive	5	80.1 ± 3.0	NS
P	*Sagina nodosa ssp. borealis*	Knotted Pearlwort				S2	3 Sensitive	1	61.1 ± 0.0	NB
P	*Stellaria longifolia*	Long-leaved Starwort				S2	3 Sensitive	7	18.1 ± 1.0	NB
P	*Atriplex franktonii*	Frankton's Saltbush				S2	4 Secure	3	16.9 ± 1.0	NB
P	*Chenopodium rubrum*	Red Pigweed				S2	3 Sensitive	4	41.7 ± 1.0	NB
P	*Hypericum dissimulatum*	Disguised St John's-wort				S2	3 Sensitive	3	79.1 ± 0.0	NB
P	*Triosteum aurantiacum*	Orange-fruited Tinker's Weed				S2	3 Sensitive	7	64.3 ± 0.0	NB
P	*Shepherdia canadensis*	Soapberry				S2	3 Sensitive	41	85.1 ± 0.0	NB
P	*Astragalus eucosmus*	Elegant Milk-vetch				S2	2 May Be At Risk	3	20.6 ± 0.0	NB
P	*Oxytropis campestris var. johannensis*	Field Locoweed				S2	3 Sensitive	27	32.4 ± 50.0	NB
P	*Quercus macrocarpa*	Bur Oak				S2	2 May Be At Risk	46	25.3 ± 1.0	NB
P	*Gentiana linearis*	Narrow-Leaved Gentian				S2	3 Sensitive	5	95.2 ± 5.0	NB
P	*Myriophyllum humile*	Low Water Milfoil				S2	3 Sensitive	6	45.2 ± 1.0	NB
P	*Proserpinaca palustris var. crebra*	Marsh Mermaidweed				S2	3 Sensitive	8	30.3 ± 0.0	NB
P	*Hedeoma pulegioides*	American False Pennyroyal				S2	4 Secure	15	26.3 ± 1.0	NB
P	*Nuphar lutea ssp. rubrodisca*	Red-disked Yellow Pond-lily				S2	3 Sensitive	10	31.2 ± 0.0	NB
P	*Orobanche uniflora*	One-Flowered Broomrape				S2	3 Sensitive	12	19.2 ± 1.0	NB
P	*Polygala paucifolia*	Fringed Milkwort				S2	3 Sensitive	12	50.7 ± 1.0	NB
P	*Polygonum amphibium var. emersum*	Water Smartweed				S2	3 Sensitive	36	16.2 ± 0.0	NB
P	*Polygonum careyi*	Carey's Smartweed				S2	3 Sensitive	12	27.7 ± 5.0	NB
P	*Podostemum ceratophyllum*	Horn-leaved Riverweed				S2	3 Sensitive	8	76.4 ± 0.0	NB
P	*Anemone parviflora*	Small-flowered Anemone				S2	3 Sensitive	8	86.4 ± 5.0	NB
P	*Hepatica nobilis var. obtusa*	Round-lobed Hepatica				S2	3 Sensitive	8	27.7 ± 1.0	NB
P	*Ranunculus flabellaris*	Yellow Water Buttercup				S2	4 Secure	14	41.1 ± 0.0	NB
P	*Crataegus scabrida*	Rough Hawthorn				S2	3 Sensitive	9	27.6 ± 1.0	NB
P	*Crataegus succulenta*	Fleshy Hawthorn				S2	3 Sensitive	1	95.8 ± 5.0	NB
P	*Cephalanthus occidentalis*	Common Buttonbush				S2	3 Sensitive	19	54.1 ± 0.0	NB
P	*Salix candida*	Sage Willow				S2	3 Sensitive	1	90.5 ± 1.0	NS
P	*Agalinis neoscotica*	Nova Scotia Agalinis				S2	3 Sensitive	5	74.3 ± 3.0	NS
P	*Euphrasia randii*	Rand's Eyebright				S2	2 May Be At Risk	4	34.8 ± 0.0	NB
P	*Scrophularia lanceolata*	Lance-leaved Figwort				S2	3 Sensitive	6	23.0 ± 5.0	NB
P	*Dirca palustris*	Eastern Leatherwood				S2	2 May Be At Risk	1	90.9 ± 1.0	NB
P	*Viola novae-angliae*	New England Violet				S2	3 Sensitive	4	30.0 ± 0.0	NB
P	*Symplocarpus foetidus*	Eastern Skunk Cabbage				S2	3 Sensitive	63	18.7 ± 0.0	NB
P	*Carex comosa*	Bearded Sedge				S2	2 May Be At Risk	10	67.2 ± 1.0	NS
P	*Carex granularis*	Limestone Meadow Sedge				S2	3 Sensitive	2	29.4 ± 5.0	NB
P	*Carex gynocrates*	Northern Bog Sedge				S2	3 Sensitive	1	28.7 ± 1.0	NB
P	*Carex hirtifolia*	Pubescent Sedge				S2	3 Sensitive	4	26.2 ± 0.0	NB
P	*Carex livida var.*	Livid Sedge				S2	3 Sensitive	1	43.0 ± 2.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
	radicaulis									
P	*Carex plantaginea*	Plantain-Leaved Sedge				S2	3 Sensitive	1	47.0 ± 0.0	NB
P	*Carex prairea*	Prairie Sedge				S2	3 Sensitive	2	94.3 ± 1.0	NS
P	*Carex rostrata*	Narrow-leaved Beaked Sedge				S2	3 Sensitive	1	43.3 ± 0.0	NB
P	*Carex salina*	Saltmarsh Sedge				S2	3 Sensitive	2	44.6 ± 1.0	NB
P	*Carex sprengelii*	Longbeak Sedge				S2	3 Sensitive	2	26.2 ± 0.0	NB
P	*Carex tenuiflora*	Sparse-Flowered Sedge				S2	2 May Be At Risk	1	59.1 ± 10.0	NB
P	*Carex albicans var. emmonsii*	White-tinged Sedge				S2	3 Sensitive	9	39.4 ± 0.0	NB
P	*Cyperus squarrosus*	Awned Flatsedge				S2	3 Sensitive	31	18.5 ± 0.0	NB
P	*Eriophorum gracile*	Slender Cottongrass				S2	2 May Be At Risk	9	64.8 ± 0.0	NB
P	*Elodea nuttallii*	Nuttall's Waterweed				S2	3 Sensitive	6	30.5 ± 0.0	NB
P	*Juncus vaseyi*	Vasey Rush				S2	3 Sensitive	6	53.7 ± 0.0	NB
P	*Allium tricoccum*	Wild Leek				S2	2 May Be At Risk	20	10.6 ± 1.0	NB
P	*Najas gracillima*	Thread-Like Naiad				S2	3 Sensitive	6	67.2 ± 0.0	NB
P	*Calypso bulbosa var. americana*	Calypso				S2	2 May Be At Risk	5	31.3 ± 0.0	NB
P	*Coeloglossum viride var. virescens*	Long-bracted Frog Orchid				S2	2 May Be At Risk	9	8.6 ± 5.0	NB
P	*Cypripedium parviflorum var. makasin*	Small Yellow Lady's-Slipper				S2	2 May Be At Risk	7	21.4 ± 1.0	NB
P	*Spiranthes lucida*	Shining Ladies'-Tresses				S2	3 Sensitive	14	9.0 ± 5.0	NB
P	*Spiranthes ochroleuca*	Yellow Ladies'-tresses				S2	2 May Be At Risk	3	59.6 ± 0.0	NS
P	*Dichanthelium linearifolium*	Narrow-leaved Panic Grass				S2	3 Sensitive	14	18.5 ± 0.0	NB
P	*Elymus canadensis*	Canada Wild Rye				S2	2 May Be At Risk	3	78.5 ± 1.0	NB
P	*Leersia virginica*	White Cut Grass				S2	2 May Be At Risk	37	40.8 ± 0.0	NB
P	*Piptatherum canadense*	Canada Rice Grass				S2	3 Sensitive	4	61.7 ± 10.0	NB
P	*Poa glauca*	Glaucous Blue Grass				S2	4 Secure	21	34.5 ± 0.0	NB
P	*Puccinellia phryganodes*	Creeping Alkali Grass				S2	3 Sensitive	2	67.9 ± 0.0	NB
P	*Schizachyrium scoparium*	Little Bluestem				S2	3 Sensitive	33	31.1 ± 0.0	NB
P	*Zizania aquatica var. aquatica*	Indian Wild Rice				S2	5 Undetermined	5	25.8 ± 0.0	NB
P	*Piptatherum pungens*	Slender Rice Grass				S2	2 May Be At Risk	4	54.1 ± 0.0	NB
P	*Potamogeton vaseyi*	Vasey's Pondweed				S2	3 Sensitive	2	47.1 ± 1.0	NB
P	*Asplenium trichomanes*	Maidenhair Spleenwort				S2	3 Sensitive	15	24.3 ± 1.0	NB
P	*Woodwardia virginica*	Virginia Chain Fern				S2	3 Sensitive	11	92.4 ± 10.0	NS
P	*Woodsia alpina*	Alpine Cliff Fern				S2	3 Sensitive	9	26.4 ± 0.0	NB
P	*Lycopodium sitchense*	Sitka Clubmoss				S2	3 Sensitive	1	73.1 ± 5.0	NB
P	*Selaginella selaginoides*	Low Spikemoss				S2	3 Sensitive	12	41.0 ± 5.0	NB
P	*Toxicodendron radicans*	Poison Ivy				S2?	3 Sensitive	11	25.4 ± 0.0	NB
P	*Symphyotrichum novi-belgii var. crenifolium*	New York Aster				S2?	5 Undetermined	6	40.9 ± 0.0	NB
P	*Humulus lupulus var. lupuloides*	Common Hop				S2?	3 Sensitive	3	93.4 ± 0.0	NB
P	*Rubus recurvicaulis*	Arching Dewberry				S2?	4 Secure	5	17.7 ± 1.0	NB
P	*Galium obtusum*	Blunt-leaved Bedstraw				S2?	4 Secure	4	25.9 ± 1.0	NB
P	*Salix myricoides*	Bayberry Willow				S2?	3 Sensitive	2	70.2 ± 0.0	NB
P	*Platanthera huronensis*	Fragrant Green Orchid				S2?	5 Undetermined	1	62.6 ± 10.0	NS
P	*Solidago altissima*	Tall Goldenrod				S2S3	4 Secure	3	21.0 ± 1.0	NB
P	*Ceratophyllum*	Prickly Hornwort				S2S3	3 Sensitive	17	17.4 ± 2.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
	echinatum									
P	*Callitriche hermaphroditica*	Northern Water-starwort				S2S3	4 Secure	8	18.3 ± 2.0	NB
P	*Lonicera oblongifolia*	Swamp Fly Honeysuckle				S2S3	3 Sensitive	1	59.6 ± 6.0	NB
P	*Elatine americana*	American Waterwort				S2S3	3 Sensitive	7	17.4 ± 2.0	NB
P	*Bartonia paniculata*	Branched Bartonia				S2S3	3 Sensitive	4	62.4 ± 0.0	NB
P	*Bartonia paniculata ssp. iodandra*	Branched Bartonia				S2S3	3 Sensitive	34	22.2 ± 1.0	NB
P	*Geranium robertianum*	Herb Robert				S2S3	4 Secure	36	16.9 ± 0.0	NB
P	*Myriophyllum quitense*	Andean Water Milfoil				S2S3	4 Secure	71	17.1 ± 0.0	NB
P	*Epilobium coloratum*	Purple-veined Willowherb				S2S3	3 Sensitive	6	40.3 ± 1.0	NB
P	*Rumex pallidus*	Seabeach Dock				S2S3	3 Sensitive	5	38.9 ± 0.0	NB
P	*Rubus pensilvanicus*	Pennsylvania Blackberry				S2S3	4 Secure	20	38.0 ± 0.0	NB
P	*Galium labradoricum*	Labrador Bedstraw				S2S3	3 Sensitive	2	72.4 ± 0.0	NB
P	*Carex adusta*	Lesser Brown Sedge				S2S3	4 Secure	9	29.1 ± 1.0	NB
P	*Corallorhiza maculata var. occidentalis*	Spotted Coralroot				S2S3	3 Sensitive	6	41.5 ± 1.0	NB
P	*Corallorhiza maculata var. maculata*	Spotted Coralroot				S2S3	3 Sensitive	4	77.7 ± 0.0	NS
P	*Listera auriculata*	Auricled Twayblade				S2S3	3 Sensitive	2	42.5 ± 0.0	NB
P	*Spiranthes cernua*	Nodding Ladies'-Tresses				S2S3	3 Sensitive	17	55.5 ± 0.0	NS
P	*Eragrostis pectinacea*	Tufted Love Grass				S2S3	4 Secure	14	26.2 ± 1.0	NB
P	*Stuckenia filiformis ssp. alpina*	Thread-leaved Pondweed				S2S3	3 Sensitive	7	28.9 ± 0.0	NB
P	*Potamogeton praelongus*	White-stemmed Pondweed				S2S3	4 Secure	11	17.1 ± 0.0	NB
P	*Isoetes acadiensis*	Acadian Quillwort				S2S3	3 Sensitive	2	74.0 ± 0.0	NS
P	*Ophioglossum pusillum*	Northern Adder's-tongue				S2S3	3 Sensitive	7	31.0 ± 1.0	NB
P	*Panax trifolius*	Dwarf Ginseng				S3	3 Sensitive	15	32.8 ± 0.0	NB
P	*Artemisia campestris*	Field Wormwood				S3	4 Secure	23	34.8 ± 0.0	NB
P	*Artemisia campestris ssp. caudata*	Field Wormwood				S3	4 Secure	74	34.8 ± 0.0	NB
P	*Erigeron hyssopifolius*	Hyssop-leaved Fleabane				S3	4 Secure	74	29.5 ± 0.0	NB
P	*Prenanthes racemosa*	Glaucous Rattlesnakeroot				S3	4 Secure	51	24.7 ± 0.0	NB
P	*Tanacetum bipinnatum ssp. huronense*	Lake Huron Tansy				S3	4 Secure	10	18.0 ± 10.0	NB
P	*Symphyotrichum boreale*	Boreal Aster				S3	3 Sensitive	7	20.8 ± 0.0	NB
P	*Betula pumila*	Bog Birch				S3	4 Secure	16	67.8 ± 0.0	NB
P	*Arabis glabra*	Tower Mustard				S3	5 Undetermined	1	34.9 ± 0.0	NB
P	*Arabis hirsuta var. pycnocarpa*	Western Hairy Rockcress				S3	4 Secure	19	24.2 ± 0.0	NB
P	*Cardamine maxima*	Large Toothwort				S3	4 Secure	25	16.6 ± 0.0	NB
P	*Subularia aquatica var. americana*	Water Awlwort				S3	4 Secure	6	43.1 ± 0.0	NB
P	*Lobelia cardinalis*	Cardinal Flower				S3	4 Secure	143	78.6 ± 0.0	NB
P	*Stellaria humifusa*	Saltmarsh Starwort				S3	4 Secure	16	34.3 ± 0.0	NB
P	*Hudsonia tomentosa*	Woolly Beach-heath				S3	4 Secure	3	63.1 ± 0.0	NB
P	*Cornus amomum ssp. obliqua*	Pale Dogwood				S3	3 Sensitive	57	31.2 ± 0.0	NB
P	*Crassula aquatica*	Water Pygmyweed				S3	4 Secure	3	41.4 ± 0.0	NB
P	*Rhodiola rosea*	Roseroot				S3	4 Secure	58	18.3 ± 0.0	NB
P	*Penthorum sedoides*	Ditch Stonecrop				S3	4 Secure	72	16.5 ± 0.0	NB
P	*Elatine minima*	Small Waterwort				S3	4 Secure	14	24.7 ± 0.0	NB
P	*Hedysarum alpinum*	Alpine Sweet-vetch				S3	4 Secure	2	19.6 ± 0.0	NB
P	*Gentianella amarella ssp. acuta*	Northern Gentian				S3	4 Secure	3	42.5 ± 0.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
P	*Geranium bicknellii*	Bicknell's Crane's-bill				S3	4 Secure	16	19.2 ± 0.0	NB
P	*Myriophyllum farwellii*	Farwell's Water Milfoil				S3	4 Secure	10	38.1 ± 0.0	NB
P	*Myriophyllum heterophyllum*	Variable-leaved Water Milfoil				S3	4 Secure	51	17.4 ± 0.0	NB
P	*Myriophyllum verticillatum*	Whorled Water Milfoil				S3	4 Secure	22	18.3 ± 0.0	NB
P	*Stachys tenuifolia*	Smooth Hedge-Nettle				S3	3 Sensitive	4	23.2 ± 0.0	NB
P	*Teucrium canadense*	Canada Germander				S3	3 Sensitive	3	78.8 ± 5.0	NS
P	*Utricularia radiata*	Little Floating Bladderwort				S3	4 Secure	30	50.0 ± 0.0	NB
P	*Nuphar lutea ssp. pumila*	Small Yellow Pond-lily				S3	4 Secure	15	26.8 ± 1.0	NB
P	*Epilobium hornemannii*	Hornemann's Willowherb				S3	4 Secure	6	42.9 ± 0.0	NB
P	*Epilobium hornemannii ssp. hornemannii*	Hornemann's Willowherb				S3	4 Secure	1	44.6 ± 0.0	NB
P	*Epilobium strictum*	Downy Willowherb				S3	4 Secure	13	18.6 ± 0.0	NB
P	*Polygala sanguinea*	Blood Milkwort				S3	3 Sensitive	18	48.1 ± 0.0	NB
P	*Polygonum arifolium*	Halberd-leaved Tearthumb				S3	4 Secure	27	41.3 ± 0.0	NB
P	*Polygonum punctatum*	Dotted Smartweed				S3	4 Secure	2	67.4 ± 0.0	NB
P	*Polygonum punctatum var. confertiflorum*	Dotted Smartweed				S3	4 Secure	6	52.6 ± 0.0	NB
P	*Polygonum scandens*	Climbing False Buckwheat				S3	4 Secure	38	17.4 ± 0.0	NB
P	*Littorella uniflora*	American Shoreweed				S3	4 Secure	9	25.9 ± 1.0	NB
P	*Primula mistassinica*	Mistassini Primrose				S3	4 Secure	10	19.3 ± 0.0	NB
P	*Pyrola minor*	Lesser Pyrola				S3	4 Secure	6	18.4 ± 1.0	NB
P	*Clematis occidentalis*	Purple Clematis				S3	4 Secure	16	30.9 ± 0.0	NB
P	*Ranunculus gmelinii*	Gmelin's Water Buttercup				S3	4 Secure	27	21.9 ± 10.0	NB
P	*Thalictrum venulosum*	Northern Meadow-rue				S3	4 Secure	68	20.9 ± 0.0	NB
P	*Amelanchier canadensis*	Canada Serviceberry				S3	4 Secure	16	30.6 ± 1.0	NB
P	*Rosa palustris*	Swamp Rose				S3	4 Secure	18	17.7 ± 1.0	NB
P	*Rubus occidentalis*	Black Raspberry				S3	4 Secure	3	28.0 ± 0.0	NB
P	*Sanguisorba canadensis*	Canada Burnet				S3	4 Secure	16	50.8 ± 0.0	NB
P	*Galium boreale*	Northern Bedstraw				S3	4 Secure	6	39.0 ± 1.0	NB
P	*Salix interior*	Sandbar Willow				S3	4 Secure	14	54.9 ± 0.0	NB
P	*Salix nigra*	Black Willow				S3	3 Sensitive	122	25.6 ± 1.0	NB
P	*Salix pedicellaris*	Bog Willow				S3	4 Secure	46	26.0 ± 0.0	NB
P	*Comandra umbellata*	Bastard's Toadflax				S3	4 Secure	1	61.4 ± 10.0	NB
P	*Veronica serpyllifolia ssp. humifusa*	Thyme-Leaved Speedwell				S3	4 Secure	10	53.4 ± 0.0	NB
P	*Boehmeria cylindrica*	Small-spike False-nettle				S3	3 Sensitive	37	67.4 ± 0.0	NB
P	*Pilea pumila*	Dwarf Clearweed				S3	4 Secure	39	16.3 ± 0.0	NB
P	*Viola adunca*	Hooked Violet				S3	4 Secure	7	26.2 ± 1.0	NB
P	*Viola nephrophylla*	Northern Bog Violet				S3	4 Secure	4	20.8 ± 0.0	NB
P	*Carex arcta*	Northern Clustered Sedge				S3	4 Secure	48	25.0 ± 0.0	NB
P	*Carex atratiformis*	Scabrous Black Sedge				S3	4 Secure	1	43.0 ± 0.0	NB
P	*Carex capillaris*	Hairlike Sedge				S3	4 Secure	17	29.0 ± 0.0	NB
P	*Carex chordorrhiza*	Creeping Sedge				S3	4 Secure	20	50.5 ± 0.0	NB
P	*Carex conoidea*	Field Sedge				S3	4 Secure	18	21.0 ± 1.0	NB
P	*Carex eburnea*	Bristle-leaved Sedge				S3	4 Secure	11	42.3 ± 0.0	NB
P	*Carex exilis*	Coastal Sedge				S3	4 Secure	86	26.2 ± 0.0	NB
P	*Carex garberi*	Garber's Sedge				S3	3 Sensitive	2	20.9 ± 0.0	NB
P	*Carex haydenii*	Hayden's Sedge				S3	4 Secure	37	16.2 ± 0.0	NB
P	*Carex lupulina*	Hop Sedge				S3	4 Secure	78	16.1 ± 5.0	NB
P	*Carex michauxiana*	Michaux's Sedge				S3	4 Secure	61	28.7 ± 0.0	NB
P	*Carex ormostachya*	Necklace Spike Sedge				S3	4 Secure	7	53.4 ± 0.0	NB
P	*Carex rosea*	Rosy Sedge				S3	4 Secure	22	21.0 ± 0.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
P	*Carex tenera*	Tender Sedge				S3	4 Secure	39	24.7 ± 0.0	NB
P	*Carex tuckermanii*	Tuckerman's Sedge				S3	4 Secure	74	16.3 ± 0.0	NB
P	*Carex wiegandii*	Wiegand's Sedge				S3	4 Secure	117	19.7 ± 1.0	NB
P	*Carex recta*	Estuary Sedge				S3	4 Secure	8	48.8 ± 0.0	NB
P	*Cyperus dentatus*	Toothed Flatsedge				S3	4 Secure	142	26.0 ± 0.0	NB
P	*Cyperus esculentus*	Perennial Yellow Nutsedge				S3	4 Secure	38	16.4 ± 0.0	NB
P	*Eleocharis intermedia*	Matted Spikerush				S3	4 Secure	1	40.6 ± 0.0	NB
P	*Eleocharis quinqueflora*	Few-flowered Spikerush				S3	4 Secure	2	32.0 ± 0.0	NB
P	*Rhynchospora capitellata*	Small-headed Beakrush				S3	4 Secure	9	29.9 ± 0.0	NB
P	*Rhynchospora fusca*	Brown Beakrush				S3	4 Secure	29	17.8 ± 5.0	NB
P	*Trichophorum clintonii*	Clinton's Clubrush				S3	4 Secure	28	35.5 ± 0.0	NB
P	*Schoenoplectus fluviatilis*	River Bulrush				S3	3 Sensitive	60	17.8 ± 0.0	NB
P	*Schoenoplectus torreyi*	Torrey's Bulrush				S3	4 Secure	29	31.2 ± 0.0	NB
P	*Lemna trisulca*	Star Duckweed				S3	4 Secure	31	17.1 ± 0.0	NB
P	*Triantha glutinosa*	Sticky False-Asphodel				S3	4 Secure	3	20.9 ± 0.0	NB
P	*Cypripedium reginae*	Showy Lady's-Slipper				S3	3 Sensitive	7	14.4 ± 1.0	NB
P	*Liparis loeselii*	Loesel's Twayblade				S3	4 Secure	13	30.6 ± 0.0	NB
P	*Platanthera blephariglottis*	White Fringed Orchid				S3	4 Secure	52	75.4 ± 0.0	NB
P	*Platanthera grandiflora*	Large Purple Fringed Orchid				S3	3 Sensitive	26	46.5 ± 5.0	NB
P	*Bromus latiglumis*	Broad-Glumed Brome				S3	3 Sensitive	21	64.2 ± 0.0	NB
P	*Calamagrostis pickeringii*	Pickering's Reed Grass				S3	4 Secure	110	51.2 ± 0.0	NB
P	*Dichanthelium depauperatum*	Starved Panic Grass				S3	4 Secure	27	55.2 ± 0.0	NB
P	*Heteranthera dubia*	Water Stargrass				S3	4 Secure	53	17.1 ± 0.0	NB
P	*Potamogeton obtusifolius*	Blunt-leaved Pondweed				S3	4 Secure	12	11.7 ± 0.0	NB
P	*Potamogeton richardsonii*	Richardson's Pondweed				S3	3 Sensitive	21	25.9 ± 0.0	NB
P	*Xyris montana*	Northern Yellow-Eyed-Grass				S3	4 Secure	31	29.7 ± 0.0	NB
P	*Zannichellia palustris*	Horned Pondweed				S3	4 Secure	7	26.9 ± 0.0	NB
P	*Adiantum pedatum*	Northern Maidenhair Fern				S3	4 Secure	3	27.7 ± 1.0	NB
P	*Cryptogramma stelleri*	Steller's Rockbrake				S3	4 Secure	2	16.8 ± 0.0	NB
P	*Asplenium trichomanes-ramosum*	Green Spleenwort				S3	4 Secure	19	31.5 ± 0.0	NB
P	*Dryopteris fragrans var. remotiuscula*	Fragrant Wood Fern				S3	4 Secure	41	15.3 ± 1.0	NB
P	*Woodsia glabella*	Smooth Cliff Fern				S3	4 Secure	44	20.2 ± 1.0	NB
P	*Equisetum palustre*	Marsh Horsetail				S3	4 Secure	6	83.6 ± 10.0	NB
P	*Isoetes tuckermanii*	Tuckerman's Quillwort				S3	4 Secure	19	15.3 ± 1.0	NB
P	*Lycopodium sabinifolium*	Ground-Fir				S3	4 Secure	16	29.9 ± 0.0	NB
P	*Huperzia appalachiana*	Appalachian Fir-Clubmoss				S3	3 Sensitive	23	26.6 ± 0.0	NB
P	*Botrychium dissectum*	Cut-leaved Moonwort				S3	4 Secure	25	27.3 ± 0.0	NB
P	*Botrychium lanceolatum var. angustisegmentum*	Lance-Leaf Grape-Fern				S3	3 Sensitive	8	25.0 ± 1.0	NB
P	*Botrychium simplex*	Least Moonwort				S3	4 Secure	3	99.1 ± 0.0	NB
P	*Polypodium appalachianum*	Appalachian Polypody				S3	4 Secure	28	18.6 ± 1.0	NB
P	*Utricularia resupinata*	Inverted Bladderwort				S3?	4 Secure	16	35.0 ± 1.0	NB
P	*Crataegus submollis*	Quebec Hawthorn				S3?	3 Sensitive	10	13.4 ± 1.0	NB
P	*Mertensia maritima*	Sea Lungwort				S3S4	4 Secure	19	16.5 ± 1.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
P	*Lobelia kalmii*	Brook Lobelia				S3S4	4 Secure	9	17.8 ± 1.0	NB
P	*Suaeda calceoliformis*	Horned Sea-blite				S3S4	4 Secure	6	17.4 ± 0.0	NB
P	*Myriophyllum sibiricum*	Siberian Water Milfoil				S3S4	4 Secure	28	18.3 ± 0.0	NB
P	*Stachys pilosa*	Hairy Hedge-Nettle				S3S4	5 Undetermined	4	49.2 ± 1.0	NB
P	*Utricularia gibba*	Humped Bladderwort				S3S4	4 Secure	22	30.1 ± 0.0	NB
P	*Rumex maritimus*	Sea-Side Dock				S3S4	4 Secure	13	77.2 ± 0.0	NB
P	*Rumex maritimus var. fueginus*	Tierra del Fuego Dock				S3S4	4 Secure	1	93.8 ± 0.0	NB
P	*Potentilla arguta*	Tall Cinquefoil				S3S4	4 Secure	4	20.4 ± 0.0	NB
P	*Rubus chamaemorus*	Cloudberry				S3S4	4 Secure	49	28.9 ± 1.0	NB
P	*Geocaulon lividum*	Northern Comandra				S3S4	4 Secure	10	40.5 ± 0.0	NB
P	*Juniperus horizontalis*	Creeping Juniper				S3S4	4 Secure	9	48.9 ± 1.0	NB
P	*Cladium mariscoides*	Smooth Twigrush				S3S4	4 Secure	16	32.1 ± 0.0	NB
P	*Eriophorum russeolum*	Russet Cottongrass				S3S4	4 Secure	14	47.3 ± 0.0	NB
P	*Triglochin gaspensis*	Gasp ├ Arrowgrass				S3S4	4 Secure	12	34.2 ± 0.0	NB
P	*Spirodela polyrrhiza*	Great Duckweed				S3S4	4 Secure	36	17.4 ± 0.0	NB
P	*Corallorhiza maculata*	Spotted Coralroot				S3S4	3 Sensitive	21	17.7 ± 1.0	NB
P	*Calamagrostis stricta*	Slim-stemmed Reed Grass				S3S4	4 Secure	7	47.2 ± 2.0	NB
P	*Distichlis spicata*	Salt Grass				S3S4	4 Secure	4	32.9 ± 0.0	NB
P	*Potamogeton oakesianus*	Oakes' Pondweed				S3S4	4 Secure	41	22.3 ± 5.0	NB
P	*Montia fontana*	Water Blinks				SH	2 May Be At Risk	2	69.3 ± 0.0	NS
P	*Solidago caesia*	Blue-stemmed Goldenrod				SX	0.1 Extirpated	2	40.3 ± 1.0	NB
P	*Carex swanii*	Swan's Sedge				SX	0.1 Extirpated	18	64.9 ± 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.

# recs	CITATION
6616	Morrison, Guy. 2011. Maritime Shorebird Survey (MSS) database. Canadian Wildlife Service, Ottawa, 15939 surveys. 86171 recs.
6062	Lepage, D. 2014. Maritime Breeding Bird Atlas Database. Bird Studies Canada, Sackville NB, 407,838 recs.
4722	eBird. 2014. eBird Basic Dataset. Version: EBD_relNov-2014. Ithaca, New York. Nov 2014. Cornell Lab of Ornithology, 25036 recs.
3249	Erskine, A.J. 1992. Maritime Breeding Bird Atlas Database. NS Museum & Nimbus Publ., Halifax, 82,125 recs.
1587	Pardieck, K.L. & Ziolkowski Jr., D.J.; Hudson, M.-A.R. 2014. North American Breeding Bird Survey Dataset 1966 - 2013, version 2013.0. U.S. Geological Survey, Patuxent Wildlife Research Center <www.pwrc.usgs.gov/BBS/RawData/>.
447	Blaney, C.S.; Mazerolle, D.M. 2009. Fieldwork 2009. Atlantic Canada Conservation Data Centre. Sackville NB, 13395 recs.
431	Blaney, C.S.; Mazerolle, D.M. 2008. Fieldwork 2008. Atlantic Canada Conservation Data Centre. Sackville NB, 13343 recs.
420	Benedict, B. Connell Herbarium Specimens. University New Brunswick, Fredericton. 2003.
407	Churchill, J.L. 2018. Atlantic Canada Conservation Data Centre Fieldwork 2017. Atlantic Canada Conservation Data Centre.
383	Clayden, S.R. 1998. NBM Science Collections databases: vascular plants. New Brunswick Museum, Saint John NB, 19759 recs.
325	Benedict, B. Connell Herbarium Specimens (Data) . University New Brunswick, Fredericton. 2003.
318	Belland, R.J. Maritimes moss records from various herbarium databases. 2014.
311	Brunelle, P.-M. (compiler). 2009. ADIP/MDDS Odonata Database: data to 2006 inclusive. Atlantic Dragonfly Inventory Program (ADIP), 24200 recs.
269	Mazerolle, D.M. 2017. Atlantic Canada Conservation Data Centre Fieldwork 2017. Atlantic Canada Conservation Data Centre.
268	Hicks, Andrew. 2009. Coastal Waterfowl Surveys Database, 2000-08. Canadian Wildlife Service, Sackville, 46488 recs (11149 non-zero).
248	Tims, J. & Craig, N. 1995. Environmentally Significant Areas in New Brunswick (NBESA). NB Dept of Environment & Nature Trust of New Brunswick Inc, 6042 recs.
226	Sollows, M.C,. 2008. NBM Science Collections databases: mammals. New Brunswick Museum, Saint John NB, download Jan. 2008, 4983 recs.
208	Tranquilla, L. 2015. Maritimes Marsh Monitoring Project 2015 data. Bird Studies Canada, Sackville NB, 5062 recs.
199	Clayden, S.R. 2007. NBM Science Collections databases: vascular plants. New Brunswick Museum, Saint John NB, download Mar. 2007, 6914 recs.
191	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.
185	Blaney, C.S. & Mazerolle, D.M. 2011. NB WTF Fieldwork on Magaguadavic & Lower St Croix Rivers. Atlantic Canada Conservation Data Centre, 4585 recs.
184	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.
182	Blaney, C.S.; Mazerolle, D.M.; Klymko, J; Spicer, C.D. 2006. Fieldwork 2006. Atlantic Canada Conservation Data Centre. Sackville NB, 8399 recs.
180	Bagnell, B.A. 2001. New Brunswick Bryophyte Occurrences. B&B Botanical, Sussex, 478 recs.

# recs	CITATION
164	Belliveau, A.G. 2018. Atlantic Canada Conservation Data Centre Fieldwork 2017. Atlantic Canada Conservation Data Centre.
163	Stewart, J.I. 2010. Peregrine Falcon Surveys in New Brunswick, 2002-09. Canadian Wildlife Service, Sackville, 58 recs.
162	Epworth, W. 2012. Species at Risk records, 2009-11. Fort Folly Habitat Recovery Program, 162 recs.
157	Parks Canada. 2010. Specimens in or near National Parks in Atlantic Canada. Canadian National Museum, 3925 recs.
149	Sollows, M.C,. 2009. NBM Science Collections databases: molluscs. New Brunswick Museum, Saint John NB, download Jan. 2009, 6951 recs (2957 in Atlantic Canada).
144	Hinds, H.R. 1986. Notes on New Brunswick plant collections. Connell Memorial Herbarium, unpubl, 739 recs.
134	Blaney, C.S.; Mazerolle, D.M.; Belliveau, A.B. 2013. Atlantic Canada Conservation Data Centre Fieldwork 2013. Atlantic Canada Conservation Data Centre, 9000+ recs.
131	Blaney, C.S.; Mazerolle, D.M. 2012. Fieldwork 2012. Atlantic Canada Conservation Data Centre, 13,278 recs.
128	Gravel, Mireille. 2010. Coordonnées GPS et suivi des tortues marquées, 2005-07. Kouchibouguac National Park, 480 recs.
124	Blaney, C.S.; Spicer, C.D.; Popma, T.M.; Hanel, C. 2002. Fieldwork 2002. Atlantic Canada Conservation Data Centre. Sackville NB, 2252 recs.
119	Newell, R.E. 2000. E.C. Smith Herbarium Database. Acadia University, Wolfville NS, 7139 recs.
115	Klymko, J.J.D. 2014. Maritimes Butterfly Atlas, 2012 submissions. Atlantic Canada Conservation Data Centre, 8552 records.
113	Bishop, G. & Papoulias, M.; Arnold (Chaplin), M. 2005. Grand Lake Meadows field notes, Summer 2005. New Brunswick Federation of Naturalists, 1638 recs.
105	Manthorne, A. 2014. MaritimesSwiftwatch Project database 2013-2014. Bird Studies Canada, Sackville NB, 326 recs.
89	Sabine, D.L. 2005. 2001 Freshwater Mussel Surveys. New Brunswick Dept of Natural Resources & Energy, 590 recs.
88	Erskine, A.J. 1999. Maritime Nest Records Scheme (MNRS) 1937-1999. Canadian Wildlife Service, Sackville, 313 recs.
87	Benedict, B. Connell Herbarium Specimen Database Download 2004. Connell Memorial Herbarium, University of New Brunswick. 2004.
85	Goltz, J.P. 2012. Field Notes, 1989-2005. , 1091 recs.
85	Mazerolle, D.M. 2016. Atlantic Canada Conservation Data Centre Fieldwork 2017. Atlantic Canada Conservation Data Centre.
78	Blaney, C.S. 2017. Atlantic Canada Conservation Data Centre Fieldwork 2017. Atlantic Canada Conservation Data Centre.
78	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.
77	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.
77	Speers, L. 2008. Butterflies of Canada database: New Brunswick 1897-1999. Agriculture & Agri-Food Canada, Biological Resources Program, Ottawa, 2048 recs.
75	Blaney, C.S.; Mazerolle, D.M.; Belliveau, A.B. 2014. Atlantic Canada Conservation Data Centre Fieldwork 2014. Atlantic Canada Conservation Data Centre, # recs.
73	Blaney, C.S.; Mazerolle, D.M.; Belliveau, A.B. 2015. Atlantic Canada Conservation Data Centre Fieldwork 2015. Atlantic Canada Conservation Data Centre, # recs.
73	Robinson, S.L. 2015. 2014 field data.
66	McNeil, J.A. 2016. Blandings Turtle (Emydoidea blandingii), Eastern Ribbonsnake (Thamnophis sauritus), Wood Turtle (Glyptemys insculpta), and Snapping Turtle (Chelydra serpentina) sightings, 2016. Mersey Tobeatic Research Institute, 774 records.
64	Blaney, C.S.; Mazerolle, D.M. 2010. Fieldwork 2010. Atlantic Canada Conservation Data Centre. Sackville NB, 15508 recs.
62	Klymko, J. 2016. Atlantic Canada Conservation Data Centre Fieldwork 2016. Atlantic Canada Conservation Data Centre.
62	Klymko, J.J.D. 2012. Maritimes Butterfly Atlas, 2010 and 2011 records. Atlantic Canada Conservation Data Centre, 6318 recs.
61	Sollows, M.C. 2008. NBM Science Collections databases: herpetiles. New Brunswick Museum, Saint John NB, download Jan. 2008, 8636 recs.
57	Benjamin, L.K. (compiler). 2012. Significant Habitat & Species Database. Nova Scotia Dept Natural Resources, 4965 recs.
57	McAlpine, D.F. 1998. NBM Science Collections: Wood Turtle records. New Brunswick Museum, Saint John NB, 329 recs.
55	Klymko, J.J.D. 2016. 2015 field data. Atlantic Canada Conservation Data Centre.
54	Boyne, A.W. 2000. Tern Surveys. Canadian Wildlife Service, Sackville, unpublished data. 168 recs.
53	Blaney, C.S. 2000. Fieldwork 2000. Atlantic Canada Conservation Data Centre. Sackville NB, 1265 recs.
53	Cowie, Faye. 2007. Surveyed Lakes in New Brunswick. Canadian Rivers Institute, 781 recs.
52	Thomas, A.W. 1996. A preliminary atlas of the butterflies of New Brunswick. New Brunswick Museum.
47	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.
45	Wilhelm, S.I. et al. 2011. Colonial Waterbird Database. Canadian Wildlife Service, Sackville, 2698 sites, 9718 recs (8192 obs).
41	Benjamin, L.K. (compiler). 2007. Significant Habitat & Species Database. Nova Scotia Dept Natural Resources, 8439 recs.
41	McAlpine, D.F. 1998. NBM Science Collections databases to 1998. New Brunswick Museum, Saint John NB, 241 recs.
41	Wissink, R. 2006. Fundy National Park Digital Database. Parks Canada, 41 recs.
39	Bateman, M.C. 2001. Coastal Waterfowl Surveys Database, 1965-2001. Canadian Wildlife Service, Sackville, 667 recs.
38	Klymko, J.J.D.; Robinson, S.L. 2014. 2013 field data. Atlantic Canada Conservation Data Centre.
38	Munro, Marian K. Nova Scotia Provincial Museum of Natural History Herbarium Database. Nova Scotia Provincial Museum of Natural History, Halifax, Nova Scotia. 2013.
37	Kennedy, Joseph. 2010. New Brunswick Peregrine records, 2009. New Brunswick Dept Natural Resources, 19 recs (14 active).
37	Klymko, J.J.D. 2018. 2017 field data. Atlantic Canada Conservation Data Centre.
36	Cowie, F. 2007. Electrofishing Population Estimates 1979-98. Canadian Rivers Institute, 2698 recs.
36	Spicer, C.D. 2002. Fieldwork 2002. Atlantic Canada Conservation Data Centre. Sackville NB, 211 recs.
35	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.
30	Blaney, C.S. 2003. Fieldwork 2003. Atlantic Canada Conservation Data Centre. Sackville NB, 1042 recs.
30	Majka, C. 2009. Université de Moncton Insect Collection: Carabidae, Cerambycidae, Coccinellidae. Université de Moncton, 540 recs.
28	Layberry, R.A. & Hall, P.W., LaFontaine, J.D. 1998. The Butterflies of Canada. University of Toronto Press. 280 pp+plates.
27	Mills, E. Connell Herbarium Specimens, 1957-2009. University New Brunswick, Fredericton. 2012.
26	Doucet, D.A. 2008. Fieldwork 2008: Odonata. ACCDC Staff, 625 recs.
25	Scott, F.W. 2002. Nova Scotia Herpetofauna Atlas Database. Acadia University, Wolfville NS, 8856 recs.

# recs	CITATION
24	Doucet, D.A. & Edsall, J.; Brunelle, P.-M. 2007. Miramichi Watershed Rare Odonata Survey. New Brunswick ETF & WTF Report, 1211 recs.
24	Hinds, H.R. 1999. Connell Herbarium Database. University New Brunswick, Fredericton, 131 recs.
23	Webster, R.P. 2004. Lepidopteran Records for National Wildlife Areas in New Brunswick. Webster, 1101 recs.
22	Sollows, M.C,. 2009. NBM Science Collections databases: Coccinellid & Cerambycid Beetles. New Brunswick Museum, Saint John NB, download Feb. 2009, 569 recs.
22	Speers, L. 2001. Butterflies of Canada database. Agriculture & Agri-Food Canada, Biological Resources Program, Ottawa, 190 recs.
21	Roland, A.E. & Smith, E.C. 1969. The Flora of Nova Scotia, 1st Ed. Nova Scotia Museum, Halifax, 743pp.
20	Belliveau, A.G. 2016. Atlantic Canada Conservation Data Centre Fieldwork 2016. Atlantic Canada Conservation Data Centre, 10695 recs.
20	Benedict, B. Connell Herbarium Specimens, Digital photos. University New Brunswick, Fredericton. 2005.
20	Tingley, S. (compiler). 2001. Butterflies of New Brunswick. , Web site: www.geocities.com/Yosemite/8425/buttrfly. 142 recs.
19	Klymko, J.J.D. 2016. 2014 field data. Atlantic Canada Conservation Data Centre.
18	Blaney, C.S.; Spicer, C.D.; Mazerolle, D.M. 2005. Fieldwork 2005. Atlantic Canada Conservation Data Centre. Sackville NB, 2333 recs.
18	McAlpine, D.F. 1983. Status & Conservation of Solution Caves in New Brunswick. New Brunswick Museum, Publications in Natural Science, no. 1, 28pp.
17	Clayden, S.R. 2012. NBM Science Collections databases: vascular plants. New Brunswick Museum, Saint John NB, 57 recs.
17	Pike, E., Tingley, S. & Christie, D.S. 2000. Nature NB Listserve. University of New Brunswick, listserv.unb.ca/archives/naturenb. 68 recs.
15	Blaney, C.S.; Mazerolle, D.M.; Oberndorfer, E. 2007. Fieldwork 2007. Atlantic Canada Conservation Data Centre. Sackville NB, 13770 recs.
14	Caissie, A. Herbarium Records. Fundy National Park, Alma NB. 1961-1993.
14	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.
14	Zinck, M. & Roland, A.E. 1998. Roland's Flora of Nova Scotia. Nova Scotia Museum, 3rd ed., rev. M. Zinck; 2 Vol., 1297 pp.
13	Downes, C. 1998-2000. Breeding Bird Survey Data. Canadian Wildlife Service, Ottawa, 111 recs.
13	Edsall, J. 2001. Lepidopteran records in New Brunswick, 1997-99. , Pers. comm. to K.A. Bredin. 91 recs.
13	Klymko, J.J.D.; Robinson, S.L. 2012. 2012 field data. Atlantic Canada Conservation Data Centre, 447 recs.
13	Wissink, R. 2000. Rare Plants of Fundy: maps. Parks Canada, 20 recs.
12	Kennedy, Joseph. 2010. New Brunswick Peregrine records, 2010. New Brunswick Dept Natural Resources, 16 recs (11 active).
10	Amirault, D.L. & Stewart, J. 2007. Piping Plover Database 1894-2006. Canadian Wildlife Service, Sackville, 3344 recs, 1228 new.
10	Basquill, S.P. 2003. Fieldwork 2003. Atlantic Canada Conservation Data Centre, Sackville NB, 69 recs.
10	Noseworthy, J. 2013. Van Brunt's Jacob's-ladder observations along tributary of Dipper Harbour Ck. Nature Conservancy of Canada, 10 recs.
9	Benedict, B. Connell Herbarium Specimens. University New Brunswick, Fredericton. 2000.
9	Bredin, K.A. 2001. WTF Project: Freshwater Mussel Fieldwork in Freshwater Species data. Atlantic Canada Conservation Data Centere, 101 recs.
9	Doucet, D.A. 2007. Lepidopteran Records, 1988-2006. Doucet, 700 recs.
8	Blaney, C.S.; Mazerolle, D.M. 2011. Fieldwork 2011. Atlantic Canada Conservation Data Centre. Sackville NB.
8	Hinds, H.R. 1992. Rare Vascular Plants of Fundy National Park. , 10 recs.
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	Oldham, M.J. 2000. Oldham database records from Maritime provinces. Oldham, M.J; ONHIC, 487 recs.
7	Popma, T.M. 2003. Fieldwork 2003. Atlantic Canada Conservation Data Centre. Sackville NB, 113 recs.
6	Bateman, M.C. 2000. Waterfowl Brood Surveys Database, 1990-2000 . Canadian Wildlife Service, Sackville, unpublished data. 149 recs.
6	Benjamin, L.K. 2009. NSDNR Fieldwork & Consultants Reports. Nova Scotia Dept Natural Resources, 143 recs.
6	Blaney, C.S.; Spicer, C.D. 2001. Fieldwork 2001. Atlantic Canada Conservation Data Centre. Sackville NB, 981 recs.
6	Blaney, C.S.; Spicer, C.D.; Rothfels, C. 2004. Fieldwork 2004. Atlantic Canada Conservation Data Centre. Sackville NB, 1343 recs.
6	Edsall, J. 2007. Personal Butterfly Collection: specimens collected in the Canadian Maritimes, 1961-2007. J. Edsall, unpubl. report, 137 recs.
5	Goltz, J.P. & Bishop, G. 2005. Confidential supplement to Status Report on Prototype Quillwort (Isoetes prototypus). Committee on the Status of Endangered Wildlife in Canada, 111 recs.
5	Litvak, M.K. 2001. Shortnose Sturgeon records in four NB rivers. UNB Saint John NB. Pers. comm. to K. Bredin, 6 recs.
5	Parker, M.S.R. 2011. Hampton Wind Farm 2010: significant floral/faunal observations. , 13 recs.
5	Spicer, C.D. & Harries, H. 2001. Mount Allison Herbarium Specimens. Mount Allison University, 128 recs.
4	Belliveau, A.G. 2014. Plant Records from Southern and Central Nova Scotia. Atlantic Canada Conservation Data Centre, 919 recs.
4	Blaney, C.S. Miscellaneous specimens received by ACCDC (botany). Various persons. 2001-08.
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	Gravel, Mireille. 2010. Coordonnées des tortues des bois Salmon River Road, 2005. Kouchibouguac National Park, 4 recs.
4	Haughian, S.R. 2018. Description of Fuscopannaria leucosticta field work in 2017 . New Brunswick Museum, 314 recs.
4	Hicklin, P.W. 1995. The Maritime Shorebird Survey Newsletter. Calidris, No. 3. 6 recs.
4	Layberry, R.A. 2012. Lepidopteran records for the Maritimes, 1974-2008. Layberry Collection, 1060 recs.
4	Olsen, R. Herbarium Specimens. Nova Scotia Agricultural College, Truro. 2003.
3	Adams, J. & Herman, T.B. 1998. Thesis, Unpublished map of C. insculpta sightings. Acadia University, Wolfville NS, 88 recs.
3	Bishop, G. 2012. Field data from September 2012 Anticosti Aster collection trip. , 135 rec.
3	Bishop, G., Bagnell, B.A. 2004. Site Assessment of Musquash Harbour, Nature Conservancy of Canada Property - Preliminary Botanical Survey. B&B Botanical, 12pp.
3	Blaney, C.S. 1999. Fieldwork 1999. Atlantic Canada Conservation Data Centre. Sackville NB, 292 recs.
3	Catling, P.M. 1981. Taxonomy of autumn-flowering Spiranthes species of southern Nova Scotia in Can. J. Bot. , 59:1250-1273. 30 recs.
3	Christie, D.S. 2000. Christmas Bird Count Data, 1997-2000. Nature NB, 54 recs.

# recs	CITATION
3	Clayden, S.R. 2006. Pseudevernia cladonia records. NB Museum. Pers. comm. to S. Blaney, Dec, 4 recs.
3	Cronin, P. & Ayer, C.; Dubee, B.; Hooper, W.C.; LeBlanc, E.; Madden, A.; Pettigrew, T.; Seymour, P. 1998. Fish Species Management Plans (draft). NB DNRE Internal Report. Fredericton, 164pp.
3	Forbes, G. 2001. Bog Lemming, Phalarope records, NB. , Pers. comm. to K.A. Bredin. 6 recs.
3	Klymko, J.J.D. 2012. Insect field work & submissions. Atlantic Canada Conservation Data Centre, 852 recs.
3	Lautenschlager, R.A. 2005. Survey for Species at Risk on the Canadian Forest Service's Acadia Research Forest near Fredericton, New Brunswick. Atlantic Canada Conservation Data Centre, 6. 3 recs.
3	Marshall, L. 1998. Atlantic Salmon: Southwest New Brunswick outer-Fundy SFA 23. Dept of Fisheries & Oceans, Atlantic Region, Science. Stock Status Report D3-13. 6 recs.
3	Munro, Marian K. Nova Scotia Provincial Museum of Natural History Herbarium Database. Nova Scotia Provincial Museum of Natural History, Halifax, Nova Scotia. 2014.
3	Neily, T.H. 2013. Email communication to Sean Blaney regarding Listera australis observations made from 2007 to 2011 in Nova Scotia. , 50.
3	Powell, B.C. 1967. Female sexual cycles of Chrysemy spicta & Clemmys insculpta in Nova Scotia. Can. Field-Nat., 81:134-139. 26 recs.
3	Sabine, D.L. 2012. Bronze Copper records, 2003-06. New Brunswick Dept of Natural Resources, 5 recs.
3	Spicer, C.D. 2001. Powerline Corridor Botanical Surveys, Charlotte & Saint John Counties. A M E C International, 1269 recs.
2	Amiro, Peter G. 1998. Atlantic Salmon: Inner Bay of Fundy SFA 22 & part of SFA 23. Dept of Fisheries & Oceans, Atlantic Region, Science Stock Status Report D3-12. 4 recs.
2	Bagnell, B.A. 2003. Update to New Brunswick Rare Bryophyte Occurrences. B&B Botanical, Sussex, 5 recs.
2	Basquill, S.P. 2011 vascular plant field data. Nova Scotia Department of Natural Resources, 37 recs.
2	Benjamin, L.K. 2011. NSDNR fieldwork & consultant reports 1997, 2009-10. Nova Scotia Dept Natural Resources, 85 recs.
2	Cameron, R.P. 2009. Cyanolichen database. Nova Scotia Environment & Labour, 1724 recs.
2	Edsall, J. 1992. Summer 1992 Report. New Brunswick Bird Info Line, 2 recs.
2	Edsall, J. 1993. Spring 1993 Report. New Brunswick Bird Info Line, 3 recs.
2	Gautreau-Daigle, H. 2007. Rare plant records from peatland surveys. Coastal Zones Research Institute, Shippagan NB. Pers. comm. to D.M. Mazerolle, 39 recs.
2	Goltz, J.P. 2002. Botany Ramblings: 1 July to 30 September, 2002. N.B. Naturalist, 29 (3):84-92. 7 recs.
2	Hinds, H.R. 1999. A Vascular Plant Survey of the Musquash Estuary in New Brunswick. , 12pp.
2	Toner, M. 2001. Lynx Records 1973-2000. NB Dept of Natural Resources, 29 recs.
2	Tremblay, E. 2006. Kouchibouguac National Park Digital Database. Parks Canada, 105 recs.
2	Walker, E.M. 1942. Additions to the List of Odonates of the Maritime Provinces. Proc. Nova Scotian Inst. Sci., 20. 4: 159-176. 2 recs.
2	Webster, R.P. & Edsall, J. 2007. 2005 New Brunswick Rare Butterfly Survey. Environmental Trust Fund, unpublished report, 232 recs.
1	Amirault, D.L. & McKnight, J. 2003. Piping Plover Database 1991-2003. Canadian Wildlife Service, Sackville, unpublished data. 7 recs.
1	Amirault, D.L. 1997-2000. Unpublished files. Canadian Wildlife Service, Sackville, 470 recs.
1	Belliveau, A. 2013. email to Sean Blaney regarding Listera australis observations in SW Nova Scotia. Mersey Tobeatic Research Institute, 8.
1	Belliveau, A. 2013. Rare species records from Nova Scotia. Mersey Tobeatic Research Institute, 296 records. 296 recs.
1	Benjamin, L.K. 2012. NSDNR fieldwork & consultant reports 2008-2012. Nova Scotia Dept Natural Resources, 196 recs.
1	Boyne, A.W. 2000. Harlequin Duck Surveys. Canadian Wildlife Service, Sackville, unpublished data. 5 recs.
1	Bredin, K.A. 2000. NB & NS Bog Project, fieldwork. Atlantic Canada Conservation Data Centre, Sackville, 1 rec.
1	Bredin, K.A. 2001. NB Freshwater Mussel Fieldwork. Atlantic Canada Conservation Data Centere, 16 recs.
1	Brunelle, P.-M. 2005. Wood Turtle observations. Pers. comm. to S.H. Gerriets, 21 Sep. 3 recs, 3 recs.
1	Cameron, R.P. 2009. Erioderma pedicellatum database, 1979-2008. Dept Environment & Labour, 103 recs.
1	Clavette, A., and others. 2013. Peregrine Falcon nesting information from NatureNB listserv. NatureNB.
1	Clayden, S.R. 2007. NBM Science Collections. Pers. comm. to D. Mazerolle, 1 rec.
1	COSEWIC (Committee on the Status of Wildlife in Canada). 2013. COSEWIC Assessment and Status Report on the Eastern Waterfan Peltigera hydrothyria in Canada. COSEWIC, 46 pp.
1	Crowell, M.J. Plant specimens from Nictaux, NS sent to Sean Blaney for identification. Jacques Whitford Limited. 2005.
1	Dadswell, M.J. 1979. Status Report on Shortnose Sturgeon (Acipenser brevirostrum) in Canada. Committee on the Status of Endangered Wildlife in Canada, 15 pp.
1	Daury, R.W. & Bateman, M.C. 1996. The Barrow's Goldeneye (Bucephala islandica) in the Atlantic Provinces and Maine. Canadian Wildlife Service, Sackville, 47pp.
1	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.
1	Doucet, D.A. & Edsall, J. 2007. Ophiogomphus howei records. Atlantic Canada Conservation Data Centre, Sackville NB, 21 recs.
1	Edsall, J. 1993. Summer 1993 Report. New Brunswick Bird Info Line, 2 recs.
1	Edsall, J. 2007. Lepidopteran Records from Halls Creek, 1994-2000. Edsall, 43 recs.
1	Goltz, J.P. 2001. Botany Ramblings April 29-June 30, 2001. N.B. Naturalist, 28 (2): 51-2. 8 recs.
1	Hill, N. 2014. 2014 Monarch email report, Bridgetown, NS. Fern Hill Institute for Plant Conservation.
1	Hill, N.M. 1994. Status report on the Long's bulrush Scirpus longii in Canada. Committee on the Status of Endangered Wildlife in Canada, 7 recs.
1	Hinds, H.R. 2000. Rare plants of Fundy in Rare Plants of Fundy: maps. Wissink, R. (ed.) Parks Canada, 2 recs.
1	Jessop, B. 2004. Acipenser oxyrinchus locations. Dept of Fisheries & Oceans, Atlantic Region, Pers. comm. to K. Bredin. 1 rec.
1	Kirkland, G.L. Jr. & Schmidt, D.F. 1982. Abundance, habitat, reproduction & morphology of forest-dwelling small mammals of NS & south-eastern NB. Can. Field-Nat., 96(2): 156-162. 1 rec.
1	Kirkland, G.L. Jr., Schmidt, D.F. & Kirkland, C.J. 1979. First record of the long-tailed shrew (Sorex dispar) in New Brunswick. Can. Field-Nat., 93: 195-198. 1 rec.
1	Klymko, J.J.D. 2010. Miscellaneous observations reported to ACCDC (zoology). Pers. comm. from various persons, 3 recs.
1	Klymko, J.J.D. 2012. Insect fieldwork & submissions, 2011. Atlantic Canada Conservation Data Centre. Sackville NB, 760 recs.
1	LaFlamme, C. 2008. Disovery of Goodyera pubescens at Springdale, NB. Amec Earth and Environmental. Pers. comm. to D.M. Mazerolle, 1 rec.
1	Loo, J. & MacDougall, A. 1994. GAP analysis: Summary Report. Fundy Model Forest, 2 recs.
1	MacKinnon, D.S. 2013. Email report of Peregrine Falcon nest E of St. Martins NB. NS Department of Environment and Labour, 1 record.
1	Madden, A. 1998. Wood Turtle records in northern NB. New Brunswick Dept of Natural Resources & Energy, Campbellton, Pers. comm. to S.H. Gerriets. 16 recs.

# recs	CITATION
1	McAlpine, D.F. & Collingwood, L. 1989. Rare Salamander Survey in Fundy National Park. Fundy National Park, Internal Documents, 1 rec.
1	McAlpine, D.F. & Cox, S.L., McCabe, D.A., Schnare, J.-L. 2004. Occurrence of the Long-tailed Shrew (Sorex dispar) in the Nerepis Hills NB. Northeastern Naturalist, vol 11 (4) 383-386. 1 rec.
1	McAlpine, D.F. 1983. Species Record Cards. Fundy National Park, Library, 1 rec.
1	Miller, D.G. 2013. Peregrine Falcon nesting information from birdingnewbrunswick.ca. birdingnewbrunswick.ca.
1	Neily, T.H. & Pepper, C.; Toms, B. 2013. Nova Scotia lichen location database. Mersey Tobeatic Research Institute, 1301 records.
1	Nye, T. 2002. Wood Turtle observations in Westmorland, Queens Cos. , Pers. com. to S.H. Gerriets, Dec. 3. 3 recs.
1	Poirier, Nelson. 2012. Geranium robertianum record for NB. Pers. comm. to S. Blaney, Sep. 6, 1 rec.
1	Popma, K. 2001. Phalarope & other bird observations in Westmorland Co. , Pers. comm. to K.A. Bredin. 5 recs.
1	Porter, C.J.M. 2014. Field work data 2007-2014. Nova Scotia Nature Trust, 96 recs.
1	Sabine, D.L. & Goltz, J.P. 2006. Discovery of Utricularia resupinata at Little Otter Lake, CFB Gagetown. Pers. comm. to D.M. Mazerolle, 1 rec.
1	Sabine, D.L. 2004. Specimen data: Whittaker Lake & Marysville NB. Pers. comm. to C.S. Blaney, 2pp, 4 recs.
1	Sabine, D.L. 2013. Dwaine Sabine butterfly records, 2009 and earlier.
1	Smith, M. 2013. Email to Sean Blaney regarding Schizaea pusilla at Caribou Plain Bog, Fundy NP. pers. comm., 1 rec.
1	Steeves, R. 2004. Goodyera pubescens occurrence from Colpitts Brook, Albert Co. , Pers. comm. to C.S. Blaney. 1 rec.
1	Taylor, Eric B. 1997. Status of the Sympatric Smelt (genus Osmerus) Populations of Lake Utopia, New Brunswick. Committee on the Status of Endangered Wildlife in Canada, 1 rec.
1	Toner, M. 2005. Listera australis population at Bull Pasture Plains. NB Dept of Natural Resources. Pers. comm. to S. Blaney, 8 recs.
1	Toner, M. 2009. Wood Turtle Sightings. NB Dept of Natural Resources. Pers. comm. to S. Gerriets, Jul 13 & Sep 2, 2 recs.
1	Toner, M. 2011. Wood Turtle sighting. NB Dept of Natural Resources. Pers. com. to S. Gerriets, Sep 2, photo, 1 rec.
1	Torenvliet, Ed. 2010. Wood Turtle roadkill. NB Dept of Transport. Pers. com. to R. Lautenschlager, Aug. 20, photos, 1 rec.
1	Wissink, R. 2000. Four-toed Salamander Survey results, 2000. Fundy National Park, Internal Documents, 1 rec.

Appendix B

Wetland Delineation and Functional Assessment Data

Wetland #1

Size: Area delineated is 0.06 ha.

Wetland Classification: Shrub Swamp

Dominant Wetland Vegetation (per 50/20 rule):

>50% Hydrophytic Vegetation?: Yes

- *Trees*: None (harvested in 2010).
- *Shrub:* 20% white meadowsweet (*Spiraea alba*, FAC); 15% steeplebush (*Spiraea tomentosa*, FAC); 5% red maple (*Acer rubrum,* FAC).
- *Herb:* 60% woolgrass (*Scirpus cyperinus*, FACW), 10% grass-leaved goldenrod (*Euthamia graminifolia*, FAC), 5% narrow-leaved cattail (*Typha angustifolia*, OBL), 5% marsh bedstraw (*Galium palustre*, FACW+); 2% necklace sedge (*Carex projecta*, FACW).

Primary Wetland Hydrology Indicators Present: Saturation (A3).

Secondary Wetland Hydrology Indicators Present: None.

Soil Profile:

- 4-0" organics (muck);
- 0-3" 7.5 YR 2.5/1 (98%)/ 2.5YR 5/6 (2%) redox concentrations;
- Restrictive layer: bedrock.
- Hydric Soil Indicators: Depleted Below Dark Surface (A11).

Notes:

- Position: Terrene;
- Landform: Slope;
- Water Flow Path: Outflow;
- Water Regime: Seasonally saturated;
- Wetland Origin: Unknown, possible result of tree removal and soil compaction;
- Wetland Soils: Mineral;
- Human Impact: Tree removal, soil compaction/rutting.

Cover Page: Basic Description of Assessment	**WESP-AC version 2**
Site Name:	WL #1
Investigator Name:	CK
Date of Field Assessment:	Aug 14th, 2018
Nearest Town:	Upham
Latitude (decimal degrees):	
Longitude (decimal degrees):	
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	
What percent (approx.) of the **wetland** were you able to visit?	
What percent (approx.) of the **AA** were you able to visit?	
Were you able to ask the site owner/manager about any of the questions?	The site logged ~Aug 2010
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	Sept 2016
How many wetlands have you assessed previously using WESP-AC? (approx.)	>100
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

Assessment Area (AA) Results:

Wetland ID:

Date:

Observer:

Latitude & Longitude (decimal degrees):

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)	6.27	Higher	3.24	Moderate	6.55	3.30
Stream Flow Support (SFS)	2.19	Lower	4.49	Moderate	1.17	2.62
Water Cooling (WC)	0.00	Lower	0.00	Lower	0.00	0.00
Sediment Retention & Stabilisation (SR)	7.56	Higher	1.83	Lower	8.33	1.11
Phosphorus Retention (PR)	2.67	Moderate	1.40	Lower	4.80	1.60
Nitrate Removal & Retention (NR)	2.73	Moderate	4.38	Moderate	5.51	5.00
Carbon Sequestration (CS)	4.58	Moderate			6.54	
Organic Nutrient Export (OE)	2.76	Lower			3.80	
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)	6.36	Higher	0.79	Lower	6.11	1.67
Amphibian & Turtle Habitat (AM)	3.03	Lower	0.73	Lower	4.90	2.54
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)	6.16	Moderate	2.50	Lower	5.11	2.50
Pollinator Habitat (POL)	6.78	Moderate	0.00	Lower	5.46	0.00
Native Plant Habitat (PH)	4.58	Moderate	4.06	Moderate	4.93	3.52
Public Use & Recognition (PU)			1.92	Lower		1.70
Wetland Sensitivity (Sens)			3.05	Moderate		3.12
Wetland Ecological Condition (EC)			4.94	Moderate		7.08
Wetland Stressors (STR) (higher score means more stress)			8.01	Higher		5.20
Summary Ratings for Grouped Functions:						

New Brunswick Reference Scores

Min	Max	Range	F_JenksLo	F_JenksHigh	Min	Max	Range	B_JenksLo	B_JenksHigh
1.73	9.42	7.68	2.48	5.12	0.08	10.00	9.92	2.58	5.67
0.00	5.33	5.33	2.92	6.56	0.00	5.83	5.83	2.08	6.16
0.00	6.67	6.67	1.80	5.30	0.00	6.02	6.02	1.45	4.79
3.16	10.00	6.84	1.76	5.26	0.00	6.07	6.07	3.75	7.95
2.90	10.00	7.10	2.66	4.17	0.33	9.38	9.04	1.71	4.55
3.83	10.00	6.17	2.27	4.36	1.11	10.00	8.89	2.50	7.19
4.56	8.88	4.31	3.13	5.70					
2.33	7.64	5.30	3.12	5.26					
0.00	6.13	6.13	1.80	6.71	0.00	7.39	7.39	0.00	4.44
0.00	5.95	5.95	1.40	6.29	0.00	7.09	7.09	0.00	4.48
3.87	7.39	3.52	2.58	5.58	1.24	6.64	5.39	0.85	5.74
3.30	8.58	5.28	3.30	6.25	2.09	8.16	6.06	2.27	6.30
0.00	7.96	7.96	0.00	6.84	0.00	10.00	10.00	0.83	6.67
0.00	8.54	8.54	1.95	5.42	0.00	10.00	10.00	0.00	6.67
0.00	8.29	8.29	2.50	7.24	0.00	10.00	10.00	3.33	6.67
0.00	8.05	8.05	0.00	7.81	0.00	10.00	10.00	0.00	6.67
3.08	7.12	4.03	3.96	5.98	0.00	8.68	8.68	0.00	6.33
					0.33	7.44	7.11	2.40	5.51
					2.20	5.20	2.99	2.88	5.30
					4.24	10.00	5.76	3.25	6.39
					2.26	5.93	3.67	2.15	4.97

Wetland #2

Size: Area delineated is 0.02 ha.

Wetland Classification: Vernal Pond (in a gypsum depression)

Dominant Wetland Vegetation (per 50/20 rule):

>50% Hydrophytic Vegetation?: Yes

- *Trees*: None.
- *Shrub:* 10% red osier dogwood (*Cornus sericea*, FACW); 5% common elderberry (*Sambucus nigra*, FACW).
- *Herb:* 60% common spikerush (Elelocharis palustris, OBL); 15% woolgrass (FACW), 5% slender manna-grass (*Glyceria melicaria*, OBL).

Primary Wetland Hydrology Indicators Present: Surface Water (A1); High Water Table (A2); Saturation (A3); Inundation Visible in Aerial Imagery (B7); Aqautic Fauna (B13).

Secondary Wetland Hydrology Indicators Present: Geomorphic position (D2).

Soil Profile:

- 0-4" 7.5YR 3/2 (90%)/ 2.5YR 4/6 (10%) w/ redox concentrations;
- 4-12" 5YR 4/2 (90%)/ 2.5 YR 5/6 (10%) w/ redox concentrations;
- 12-20" 5YR 4/2 (90%)/ 2.5YR 4/6 (5%) w/ redox concentrations/ Gley 1 3/10GY (5%);
- Restrictive layer: Bedrock.
- Hydric Soil Indicators: Redox Depression (F8).

Notes:

- Position: Terrene;
- Landform: Basin;
- Water Flow Path: Isolated;
- Water Regime: Seasonally flooded;
- Wetland Origin: Natural;
- Wetland Soils: Mineral;
- Human Impact: Adjacent upland tree removal.

Cover Page: Basic Description of Assessment	**WESP-AC version 2**
Site Name:	WL #2
Investigator Name:	CK
Date of Field Assessment:	Aug 14th, 2018
Nearest Town:	Upham
Latitude (decimal degrees):	
Longitude (decimal degrees):	
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	
What percent (approx.) of the **wetland** were you able to visit?	
What percent (approx.) of the **AA** were you able to visit?	
Were you able to ask the site owner/manager about any of the questions?	The site was logged ~ Aug 2010
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	Sept 2016
How many wetlands have you assessed previously using WESP-AC? (approx.)	>100
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

Assessment Area (AA) Results:

Wetland ID:

Date:

Observer:

Latitude & Longitude (decimal degrees):

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)	7.90	Higher	2.06	Lower	7.80	2.13
Stream Flow Support (SFS)	0.00	Lower	0.00	Lower	0.00	0.00
Water Cooling (WC)	1.67	Lower	0.00	Lower	1.11	0.00
Sediment Retention & Stabilisation (SR)	10.00	Higher	0.98	Lower	10.00	0.59
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)	3.52	Moderate			6.08	
Organic Nutrient Export (OE)	3.40	Moderate			4.14	
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)	5.24	Moderate	5.09	Moderate	5.72	3.99
Amphibian & Turtle Habitat (AM)	9.20	Higher	4.11	Moderate	8.16	4.59
Waterbird Feeding Habitat (WBF)	7.40	Higher	3.33	Moderate	5.89	3.33
Waterbird Nesting Habitat (WBN)	6.25	Higher	3.33	Moderate	5.34	3.33
Songbird, Raptor, & Mammal Habitat (SBM)	5.48	Moderate	3.33	Moderate	4.54	3.33
Pollinator Habitat (POL)	6.89	Moderate	3.33	Moderate	5.55	3.33
Native Plant Habitat (PH)	2.29	Lower	5.15	Moderate	4.01	4.47
Public Use & Recognition (PU)			1.92	Lower		1.70
Wetland Sensitivity (Sens)			2.00	Lower		2.80
Wetland Ecological Condition (EC)			4.58	Moderate		6.88
Wetland Stressors (STR) (higher score means more stress)			0.53	Lower		2.46
Summary Ratings for Grouped Functions:						

New Brunswick Reference Scores

Min	Max	Range	F_JenksLo	F_JenksHigh	Min	Max	Range	B_JenksLo	B_JenksHigh
1.73	9.42	7.68	2.48	5.12	0.08	10.00	9.92	2.58	5.67
0.00	5.33	5.33	2.92	6.56	0.00	5.83	5.83	2.08	6.16
0.00	6.67	6.67	1.80	5.30	0.00	6.02	6.02	1.45	4.79
3.16	10.00	6.84	1.76	5.26	0.00	6.07	6.07	3.75	7.95
2.90	10.00	7.10	2.66	4.17	0.33	9.38	9.04	1.71	4.55
3.83	10.00	6.17	2.27	4.36	1.11	10.00	8.89	2.50	7.19
4.56	8.88	4.31	3.13	5.70					
2.33	7.64	5.30	3.12	5.26					
0.00	6.13	6.13	1.80	6.71	0.00	7.39	7.39	0.00	4.44
0.00	5.95	5.95	1.40	6.29	0.00	7.09	7.09	0.00	4.48
3.87	7.39	3.52	2.58	5.58	1.24	6.64	5.39	0.85	5.74
3.30	8.58	5.28	3.30	6.25	2.09	8.16	6.06	2.27	6.30
0.00	7.96	7.96	0.00	6.84	0.00	10.00	10.00	0.83	6.67
0.00	8.54	8.54	1.95	5.42	0.00	10.00	10.00	0.00	6.67
0.00	8.29	8.29	2.50	7.24	0.00	10.00	10.00	3.33	6.67
0.00	8.05	8.05	0.00	7.81	0.00	10.00	10.00	0.00	6.67
3.08	7.12	4.03	3.96	5.98	0.00	8.68	8.68	0.00	6.33
					0.33	7.44	7.11	2.40	5.51
					2.20	5.20	2.99	2.88	5.30
					4.24	10.00	5.76	3.25	6.39
					2.26	5.93	3.67	2.15	4.97

Wetland #3

Size: Area delineated is 1.8 ha (wetland area extends beyond Project Area).

Wetland Classification: Fen/ Wet Meadow complex

Dominant Wetland Vegetation (per 50/20 rule):

>50% Hydrophytic Vegetation?: Yes

- *Trees*: None.
- *Shrub:* 15% speckled alder (*Alnus incana*, FACW); 5% steeplebush (FAC); and 5% red-osier dogwood (FACW).
- *Herb:* 60% common spikerush (OBL); 15% woolgrass (FACW), 5% common water parsnip (*Sium suave*, OBL); and 5% marsh seedbox (*Ludwigia palustris,* OBL).

Primary Wetland Hydrology Indicators Present: Surface Water (A1); High Water Table (A2); Saturation (A3); Inundation Visible in Aerial Imagery (B7); Aqautic Fauna (B13).

Secondary Wetland Hydrology Indicators Present: Surface Soil Cracks (B6).

Soil Profile:

- 11-0" organics (muck);
- 0-10" 7.5YR 3/1 (100%)
- 10-14" Gley 1 5/10GY
- Restrictive layer: gravels.
- Hydric Soil Indicators: Histic Epipedon (A2).

Notes:

- Position: Lotic Stream;
- Landform: Floodplain;
- Water Flow Path: Throughflow;
- Water Regime: Permanently flooded/permanently saturated;
- Wetland Origin: Natural;
- Wetland Soils: Mineral and organic;
- Human Impact: Adjacent upland tree removal.

Cover Page: Basic Description of Assessment	**WESP-AC version 2**
Site Name:	WL #3
Investigator Name:	CK
Date of Field Assessment:	Aug 14th, 2018
Nearest Town:	Upham
Latitude (decimal degrees):	
Longitude (decimal degrees):	
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	
What percent (approx.) of the **wetland** were you able to visit?	
What percent (approx.) of the **AA** were you able to visit?	
Were you able to ask the site owner/manager about any of the questions?	The site was logged ~Aug 2010
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	Sept 2016
How many wetlands have you assessed previously using WESP-AC? (approx.)	>100
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

Assessment Area (AA) Results:

Wetland ID:

Date:

Observer:

Latitude & Longitude (decimal degrees):

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)	2.58	Moderate	2.01	Lower	3.72	2.08
Stream Flow Support (SFS)	6.35	Moderate	7.06	Higher	3.39	4.12
Water Cooling (WC)	3.17	Moderate	8.11	Higher	2.11	4.88
Sediment Retention & Stabilisation (SR)	3.47	Moderate	7.03	Moderate	5.53	4.27
Phosphorus Retention (PR)	2.61	Lower	5.90	Higher	4.76	5.67
Nitrate Removal & Retention (NR)	1.84	Lower	10.00	Higher	4.97	10.00
Carbon Sequestration (CS)	4.27	Moderate			6.40	
Organic Nutrient Export (OE)	6.64	Higher			5.85	
Anadromous Fish Habitat (FA)	8.32	Higher	3.73	Moderate	5.10	2.76
Resident Fish Habitat (FR)	6.89	Higher	3.61	Moderate	4.10	2.56
Aquatic Invertebrate Habitat (INV)	4.94	Moderate	8.44	Higher	5.61	5.79
Amphibian & Turtle Habitat (AM)	5.87	Moderate	7.29	Higher	6.40	6.51
Waterbird Feeding Habitat (WBF)	8.54	Higher	5.00	Moderate	6.80	5.00
Waterbird Nesting Habitat (WBN)	5.43	Higher	5.00	Moderate	4.64	5.00
Songbird, Raptor, & Mammal Habitat (SBM)	9.33	Higher	5.00	Moderate	7.74	5.00
Pollinator Habitat (POL)	9.35	Higher	3.33	Moderate	7.53	3.33
Native Plant Habitat (PH)	8.08	Higher	7.14	Higher	6.34	6.20
Public Use & Recognition (PU)			1.92	Lower		1.70
Wetland Sensitivity (Sens)			5.73	Higher		3.92
Wetland Ecological Condition (EC)			5.42	Moderate		7.36
Wetland Stressors (STR) (higher score means more stress)			2.48	Moderate		3.17
Summary Ratings for Grouped Functions:						

New Brunswick Reference Scores

Min	Max	Range	F_JenksLo	F_JenksHigh	Min	Max	Range	B_JenksLo	B_JenksHigh
1.73	9.42	7.68	2.48	5.12	0.08	10.00	9.92	2.58	5.67
0.00	5.33	5.33	2.92	6.56	0.00	5.83	5.83	2.08	6.16
0.00	6.67	6.67	1.80	5.30	0.00	6.02	6.02	1.45	4.79
3.16	10.00	6.84	1.76	5.26	0.00	6.07	6.07	3.75	7.95
2.90	10.00	7.10	2.66	4.17	0.33	9.38	9.04	1.71	4.55
3.83	10.00	6.17	2.27	4.36	1.11	10.00	8.89	2.50	7.19
4.56	8.88	4.31	3.13	5.70					
2.33	7.64	5.30	3.12	5.26					
0.00	6.13	6.13	1.80	6.71	0.00	7.39	7.39	0.00	4.44
0.00	5.95	5.95	1.40	6.29	0.00	7.09	7.09	0.00	4.48
3.87	7.39	3.52	2.58	5.58	1.24	6.64	5.39	0.85	5.74
3.30	8.58	5.28	3.30	6.25	2.09	8.16	6.06	2.27	6.30
0.00	7.96	7.96	0.00	6.84	0.00	10.00	10.00	0.83	6.67
0.00	8.54	8.54	1.95	5.42	0.00	10.00	10.00	0.00	6.67
0.00	8.29	8.29	2.50	7.24	0.00	10.00	10.00	3.33	6.67
0.00	8.05	8.05	0.00	7.81	0.00	10.00	10.00	0.00	6.67
3.08	7.12	4.03	3.96	5.98	0.00	8.68	8.68	0.00	6.33
					0.33	7.44	7.11	2.40	5.51
					2.20	5.20	2.99	2.88	5.30
					4.24	10.00	5.76	3.25	6.39
					2.26	5.93	3.67	2.15	4.97

Wetland #4

Size: Area delineated is 0.30 ha.

Wetland Classification: Bog.

Dominant Wetland Vegetation (per 50/20 rule):

>50% Hydrophytic Vegetation?: Yes

- *Trees*: 5% black spruce (*Picea mariana*, FACW); and 2% eastern larch (*Larix laricina*, FAC).
- *Shrub:* 50% leatherleaf (*Chamaedaphne calyculata*, OBL); 15% rhodora (*Rhododendron canadense*, FAC); 10% sheep laurel (*Kalmia angustifolia,* FAC); and 5% false holly (Nemopanthus mucronatus, FAC).
- *Herb:* 5% large cranberry (*Vaccinium macrocarpon*, FACW+), 5% tawny cottongrass (*Eriophorum virginicum*, OBL); and Carex

Primary Wetland Hydrology Indicators Present: Surface Water (A1); High Water Table (A2); Saturation (A3).

Secondary Wetland Hydrology Indicators Present: Stunted or Stressed Plants (D1).

Soil Profile:

- 48+" organics (peat);
- Restrictive layer: unknown.
- Hydric Soil Indicators: Histosol (A1).

Notes:

- Position: Terrene;
- Landform: Basin;
- Water Flow Path: Isolated;
- Water Regime: Seasonally flooded; permanently saturated;
- Wetland Origin: Natural;
- Wetland Soils: Organic;
- Human Impact: Adjacent Tree removal, soil compaction/rutting, access road development, possible borrow pitting.

Cover Page: Basic Description of Assessment	**WESP-AC version 2**
Site Name:	WL #4
Investigator Name:	CK
Date of Field Assessment:	Aug 15th, 2018
Nearest Town:	Upham
Latitude (decimal degrees):	
Longitude (decimal degrees):	
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	
What percent (approx.) of the **wetland** were you able to visit?	
What percent (approx.) of the **AA** were you able to visit?	
Were you able to ask the site owner/manager about any of the questions?	The site was logged ~Aug 2010
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	Sept 2016
How many wetlands have you assessed previously using WESP-AC? (approx.)	>100
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

Assessment Area (AA) Results:

Wetland ID:

Date:

Observer:

Latitude & Longitude (decimal degrees):

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)	6.91	Higher	2.06	Lower	7.04	2.13
Stream Flow Support (SFS)	1.13	Lower	0.00	Lower	0.60	0.00
Water Cooling (WC)	2.00	Moderate	0.00	Lower	1.33	0.00
Sediment Retention & Stabilisation (SR)	10.00	Higher	1.69	Lower	10.00	1.02
Phosphorus Retention (PR)	3.40	Moderate	0.78	Lower	5.32	1.04
Nitrate Removal & Retention (NR)	10.00	Higher	2.69	Moderate	10.00	3.50
Carbon Sequestration (CS)	3.88	Moderate			6.23	
Organic Nutrient Export (OE)	2.30	Lower			3.56	
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)	0.04	Lower	3.43	Moderate	3.89	3.09
Amphibian & Turtle Habitat (AM)	2.03	Lower	4.07	Moderate	4.37	4.56
Waterbird Feeding Habitat (WBF)	4.57	Moderate	2.50	Moderate	3.64	2.50
Waterbird Nesting Habitat (WBN)	3.52	Moderate	2.50	Moderate	3.01	2.50
Songbird, Raptor, & Mammal Habitat (SBM)	9.09	Higher	2.50	Lower	7.54	2.50
Pollinator Habitat (POL)	8.46	Higher	0.00	Lower	6.81	0.00
Native Plant Habitat (PH)	3.99	Moderate	5.51	Moderate	4.70	4.78
Public Use & Recognition (PU)			3.35	Moderate		2.71
Wetland Sensitivity (Sens)			3.76	Moderate		3.33
Wetland Ecological Condition (EC)			10.00	Higher		10.00
Wetland Stressors (STR) (higher score means more stress)			6.19	Higher		4.53
Summary Ratings for Grouped Functions:						

New Brunswick Reference Scores

Min	Max	Range	F_JenksLo	F_JenksHigh	Min	Max	Range	B_JenksLo	B_JenksHigh
1.73	9.42	7.68	2.48	5.12	0.08	10.00	9.92	2.58	5.67
0.00	5.33	5.33	2.92	6.56	0.00	5.83	5.83	2.08	6.16
0.00	6.67	6.67	1.80	5.30	0.00	6.02	6.02	1.45	4.79
3.16	10.00	6.84	1.76	5.26	0.00	6.07	6.07	3.75	7.95
2.90	10.00	7.10	2.66	4.17	0.33	9.38	9.04	1.71	4.55
3.83	10.00	6.17	2.27	4.36	1.11	10.00	8.89	2.50	7.19
4.56	8.88	4.31	3.13	5.70					
2.33	7.64	5.30	3.12	5.26					
0.00	6.13	6.13	1.80	6.71	0.00	7.39	7.39	0.00	4.44
0.00	5.95	5.95	1.40	6.29	0.00	7.09	7.09	0.00	4.48
3.87	7.39	3.52	2.58	5.58	1.24	6.64	5.39	0.85	5.74
3.30	8.58	5.28	3.30	6.25	2.09	8.16	6.06	2.27	6.30
0.00	7.96	7.96	0.00	6.84	0.00	10.00	10.00	0.83	6.67
0.00	8.54	8.54	1.95	5.42	0.00	10.00	10.00	0.00	6.67
0.00	8.29	8.29	2.50	7.24	0.00	10.00	10.00	3.33	6.67
0.00	8.05	8.05	0.00	7.81	0.00	10.00	10.00	0.00	6.67
3.08	7.12	4.03	3.96	5.98	0.00	8.68	8.68	0.00	6.33
					0.33	7.44	7.11	2.40	5.51
					2.20	5.20	2.99	2.88	5.30
					4.24	10.00	5.76	3.25	6.39
					2.26	5.93	3.67	2.15	4.97

Wetland #5

Size: Area delineated is 1.09 ha.

Wetland Classification: Bog/ Wet Meadow complex.

Dominant Wetland Vegetation (per 50/20 rule):

>50% Hydrophytic Vegetation?: Yes

- *Trees*: 2% red maple (*Acer rubrum*, FAC); 2% black spruce (FACW); and 2% eastern larch (FAC).
- *Shrub:* 15% sheep laurel (FAC); 10% trembling aspen (*Populus tremuloides*, FAC); 10% leatherleaf (OBL); 5% rhodora (FAC); 5% false holly (Nemopanthus mucronatus, FAC); 5% steeplebush (FAC); and 5% white meadowsweet (FAC).
- *Herb:* 10% woolgrass (FACW); 5% spotted Joe-Pye weed (Eupatorium maculatum, FACW+); and 2% large cranberry (FACW+).

Primary Wetland Hydrology Indicators Present: High Water Table (A2); Saturation (A3).

Secondary Wetland Hydrology Indicators Present: Stunted or Stressed Plants (D1).

Soil Profile:

- 13-0" organics (peat);
- 0-14" 2.5YR 5/1 (100%)
- Restrictive layer: unknown.
- Hydric Soil Indicators: Histic Epipedon (A2).

Notes:

- Position: Terrene;
- Landform: Slope;
- Water Flow Path: Outflow;
- Water Regime: Seasonally flooded; permanently saturated;
- Wetland Origin: Natural;
- Wetland Soils: Organic and Mineral;

Cover Page: Basic Description of Assessment	**WESP-AC version 2**
Site Name:	WL #5
Investigator Name:	CK
Date of Field Assessment:	Aug 15th and 16th, 2018
Nearest Town:	Upham
Latitude (decimal degrees):	
Longitude (decimal degrees):	
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	
What percent (approx.) of the **wetland** were you able to visit?	
What percent (approx.) of the **AA** were you able to visit?	
Were you able to ask the site owner/manager about any of the questions?	The site was logged ~Aug 2010
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	Sept 2016
How many wetlands have you assessed previously using WESP-AC? (approx.)	>100
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

Assessment Area (AA) Results:

Wetland ID:

Date:

Observer:

Latitude & Longitude (decimal degrees):

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)	2.66	Moderate	3.27	Moderate	3.78	3.33
Stream Flow Support (SFS)	2.71	Lower	4.87	Moderate	1.44	2.84
Water Cooling (WC)	2.40	Moderate	1.55	Moderate	1.60	0.93
Sediment Retention & Stabilisation (SR)	0.26	Lower	8.16	Higher	3.34	4.95
Phosphorus Retention (PR)	2.59	Lower	7.47	Higher	4.74	7.08
Nitrate Removal & Retention (NR)	0.15	Lower	10.00	Higher	3.93	10.00
Carbon Sequestration (CS)	1.15	Lower			5.06	
Organic Nutrient Export (OE)	4.21	Moderate			4.57	
Anadromous Fish Habitat (FA)	0.00	Lower	0.00	Lower	0.00	0.00
Resident Fish Habitat (FR)	4.71	Moderate	2.81	Moderate	2.80	1.99
Aquatic Invertebrate Habitat (INV)	1.33	Lower	4.04	Moderate	4.34	3.42
Amphibian & Turtle Habitat (AM)	2.98	Lower	3.92	Moderate	4.88	4.47
Waterbird Feeding Habitat (WBF)	4.99	Moderate	2.50	Moderate	3.97	2.50
Waterbird Nesting Habitat (WBN)	3.25	Moderate	2.50	Moderate	2.78	2.50
Songbird, Raptor, & Mammal Habitat (SBM)	7.37	Higher	3.33	Moderate	6.11	3.33
Pollinator Habitat (POL)	8.55	Higher	3.33	Moderate	6.88	3.33
Native Plant Habitat (PH)	5.31	Moderate	6.27	Moderate	5.23	5.44
Public Use & Recognition (PU)			1.92	Lower		1.70
Wetland Sensitivity (Sens)			4.69	Moderate		3.61
Wetland Ecological Condition (EC)			6.39	Moderate		7.92
Wetland Stressors (STR) (higher score means more stress)			9.52	Higher		5.76
Summary Ratings for Grouped Functions:						

New Brunswick Reference Scores

Min	Max	Range	F_JenksLo	F_JenksHigh	Min	Max	Range	B_JenksLo	B_JenksHigh
1.73	9.42	7.68	2.48	5.12	0.08	10.00	9.92	2.58	5.67
0.00	5.33	5.33	2.92	6.56	0.00	5.83	5.83	2.08	6.16
0.00	6.67	6.67	1.80	5.30	0.00	6.02	6.02	1.45	4.79
3.16	10.00	6.84	1.76	5.26	0.00	6.07	6.07	3.75	7.95
2.90	10.00	7.10	2.66	4.17	0.33	9.38	9.04	1.71	4.55
3.83	10.00	6.17	2.27	4.36	1.11	10.00	8.89	2.50	7.19
4.56	8.88	4.31	3.13	5.70					
2.33	7.64	5.30	3.12	5.26					
0.00	6.13	6.13	1.80	6.71	0.00	7.39	7.39	0.00	4.44
0.00	5.95	5.95	1.40	6.29	0.00	7.09	7.09	0.00	4.48
3.87	7.39	3.52	2.58	5.58	1.24	6.64	5.39	0.85	5.74
3.30	8.58	5.28	3.30	6.25	2.09	8.16	6.06	2.27	6.30
0.00	7.96	7.96	0.00	6.84	0.00	10.00	10.00	0.83	6.67
0.00	8.54	8.54	1.95	5.42	0.00	10.00	10.00	0.00	6.67
0.00	8.29	8.29	2.50	7.24	0.00	10.00	10.00	3.33	6.67
0.00	8.05	8.05	0.00	7.81	0.00	10.00	10.00	0.00	6.67
3.08	7.12	4.03	3.96	5.98	0.00	8.68	8.68	0.00	6.33
					0.33	7.44	7.11	2.40	5.51
					2.20	5.20	2.99	2.88	5.30
					4.24	10.00	5.76	3.25	6.39
					2.26	5.93	3.67	2.15	4.97

Wetland #6

Size: Area delineated is 0.07 ha.

Wetland Classification: Bog

Dominant Wetland Vegetation (per 50/20 rule):

>50% Hydrophytic Vegetation?: Yes

- *Trees*: 5% red maple (FAC); 5% black spruce (FACW); and 2% white pine (*Pinus strobus*, FAC).
- *Shrub:* 40% leatherleaf (OBL); 10% white meadowsweet (FAC); and 10% false holly (FAC).
- *Herb:* 15% woolgrass (FACW); 15% two-seeded sedge (*Carex disperma*, FACW); 10% cinnamon fern (*Osmunda cinnamomea*, FAC); 5% tawny cottongrass (OBL); and 5% crested shield fern (*Dryopteris cristata*, FACW).

Primary Wetland Hydrology Indicators Present: High Water Table (A2); Saturation (A3).

Secondary Wetland Hydrology Indicators Present: Stunted or Stressed Plants (D1).

Soil Profile:

- 40-0" organics (peat);
- 0-8" 2.5YR 5/2 (100%)
- Restrictive layer: unknown.
- Hydric Soil Indicators: Histosol (A1).

Notes:

- Position: Terrene;
- Landform: Basin;
- Water Flow Path: Isolated;
- Water Regime: Seasonally flooded; permanently saturated;
- Wetland Origin: Natural;
- Wetland Soils: Organic;
- Human Impact: Tree removal, soil compaction/rutting.

Cover Page: Basic Description of Assessment	**WESP-AC version 2**
Site Name:	WL #6
Investigator Name:	CK
Date of Field Assessment:	Aug 16th, 2018
Nearest Town:	Upham
Latitude (decimal degrees):	
Longitude (decimal degrees):	
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	
What percent (approx.) of the **wetland** were you able to visit?	
What percent (approx.) of the **AA** were you able to visit?	
Were you able to ask the site owner/manager about any of the questions?	The site was logged ~Aug 2010
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	Sept 2016
How many wetlands have you assessed previously using WESP-AC? (approx.)	>100
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

Assessment Area (AA) Results:

Wetland ID:

Date:

Observer:

Latitude & Longitude (decimal degrees):

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)	10.00	Higher	2.06	Lower	9.43	2.13
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)	7.83	Higher	2.21	Lower	8.52	1.34
Phosphorus Retention (PR)	5.12	Higher	1.47	Lower	6.54	1.67
Nitrate Removal & Retention (NR)	10.00	Higher	4.38	Moderate	10.00	5.00
Carbon Sequestration (CS)	8.39	Higher			8.18	
Organic Nutrient Export (OE)	5.68	Higher			5.35	
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)	5.65	Higher	0.56	Lower	5.86	1.55
Amphibian & Turtle Habitat (AM)	2.67	Lower	0.44	Lower	4.71	2.36
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)	5.52	Moderate	2.50	Lower	4.58	2.50
Pollinator Habitat (POL)	6.12	Moderate	0.00	Lower	4.93	0.00
Native Plant Habitat (PH)	3.70	Lower	3.65	Moderate	4.58	3.17
Public Use & Recognition (PU)			1.92	Lower		1.70
Wetland Sensitivity (Sens)			3.96	Moderate		3.39
Wetland Ecological Condition (EC)			7.83	Higher		8.75
Wetland Stressors (STR) (higher score means more stress)			8.57	Higher		5.41
Summary Ratings for Grouped Functions:						

New Brunswick Reference Scores

Min	Max	Range	F_JenksLo	F_JenksHigh	Min	Max	Range	B_JenksLo	B_JenksHigh
1.73	9.42	7.68	2.48	5.12	0.08	10.00	9.92	2.58	5.67
0.00	5.33	5.33	2.92	6.56	0.00	5.83	5.83	2.08	6.16
0.00	6.67	6.67	1.80	5.30	0.00	6.02	6.02	1.45	4.79
3.16	10.00	6.84	1.76	5.26	0.00	6.07	6.07	3.75	7.95
2.90	10.00	7.10	2.66	4.17	0.33	9.38	9.04	1.71	4.55
3.83	10.00	6.17	2.27	4.36	1.11	10.00	8.89	2.50	7.19
4.56	8.88	4.31	3.13	5.70					
2.33	7.64	5.30	3.12	5.26					
0.00	6.13	6.13	1.80	6.71	0.00	7.39	7.39	0.00	4.44
0.00	5.95	5.95	1.40	6.29	0.00	7.09	7.09	0.00	4.48
3.87	7.39	3.52	2.58	5.58	1.24	6.64	5.39	0.85	5.74
3.30	8.58	5.28	3.30	6.25	2.09	8.16	6.06	2.27	6.30
0.00	7.96	7.96	0.00	6.84	0.00	10.00	10.00	0.83	6.67
0.00	8.54	8.54	1.95	5.42	0.00	10.00	10.00	0.00	6.67
0.00	8.29	8.29	2.50	7.24	0.00	10.00	10.00	3.33	6.67
0.00	8.05	8.05	0.00	7.81	0.00	10.00	10.00	0.00	6.67
3.08	7.12	4.03	3.96	5.98	0.00	8.68	8.68	0.00	6.33
					0.33	7.44	7.11	2.40	5.51
					2.20	5.20	2.99	2.88	5.30
					4.24	10.00	5.76	3.25	6.39
					2.26	5.93	3.67	2.15	4.97

Wetland #7

Size: Area delineated is 0.68 ha (wetland area extends beyond Project Area).

Wetland Classification: Shrub swamp

Dominant Wetland Vegetation (per 50/20 rule):

>50% Hydrophytic Vegetation?: Yes

- *Trees*: 20% balsam fir (*Abies balsamea*, FAC); 15% red maple (FAC); and 10% black spruce (FACW).
- *Shrub:* 20% speckled alder (FACW); 10% false holly (FAC); and 5% wild raisin (*Viburnum nudum*, FAC)
- *Herb:* 15% cinnamon fern (FAC); 10% interrupted fern (*Osmunda claytoniana*, FAC); 10% slender manna-grass (OBL); 5% two-seeded sedge (FACW); and 5% dwarf enchanter's nightshade (*Circaea alpina*, FAC).

Primary Wetland Hydrology Indicators Present: Surface Water (A1); High Water Table (A2); Saturation (A3); Water Stained Leaves (B9); and Aquatic Fauna (B13).

Secondary Wetland Hydrology Indicators Present: Drainage Patterns (B10).

Soil Profile:

- 4-0" organics (much);
- 0-8" 7.5YR 2.5/1 (100%);
- 8-11" 10YR 5/2 (99%)/ 2.5YR 3/6 (1%) w/ redox concentrations;
- 11-18" 10YR 5/2 (90%) / 2.5YR 3/6 (10%) w/ redox concentrations;
- Restrictive layer: unknown.
- Hydric Soil Indicators: Redox Dark Surface (F6).

Notes:

- Position: Terrene;
- Landform: Basin;
- Water Flow Path: Outflow;
- Water Regime: Seasonally flooded; permanently saturated;
- Wetland Origin: Natural;
- Wetland Soils: Mineral;
- Human Impact: Adjacent tree removal, nearby soil compaction/rutting.

Cover Page: Basic Description of Assessment	**WESP-AC version 2**
Site Name:	WL #7
Investigator Name:	CK
Date of Field Assessment:	Aug 16th, 2018
Nearest Town:	Upham
Latitude (decimal degrees):	
Longitude (decimal degrees):	
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	
What percent (approx.) of the **wetland** were you able to visit?	
What percent (approx.) of the **AA** were you able to visit?	
Were you able to ask the site owner/manager about any of the questions?	The site was logged ~Aug 2010
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	Sept 2016
How many wetlands have you assessed previously using WESP-AC? (approx.)	>100
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

Assessment Area (AA) Results:

Wetland ID:

Date:

Observer:

Latitude & Longitude (decimal degrees):

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)	2.62	Moderate	3.27	Moderate	3.74	3.33
Stream Flow Support (SFS)	5.94	Moderate	6.24	Higher	3.17	3.63
Water Cooling (WC)	6.17	Higher	6.99	Higher	4.11	4.20
Sediment Retention & Stabilisation (SR)	1.80	Moderate	7.90	Moderate	4.39	4.79
Phosphorus Retention (PR)	2.15	Lower	7.08	Higher	4.43	6.74
Nitrate Removal & Retention (NR)	1.17	Lower	10.00	Higher	4.55	10.00
Carbon Sequestration (CS)	3.20	Moderate			5.94	
Organic Nutrient Export (OE)	5.74	Higher			5.38	
Anadromous Fish Habitat (FA)	6.12	Moderate	3.10	Moderate	3.75	2.29
Resident Fish Habitat (FR)	5.36	Moderate	2.95	Moderate	3.19	2.09
Aquatic Invertebrate Habitat (INV)	3.12	Moderate	6.36	Higher	4.97	4.68
Amphibian & Turtle Habitat (AM)	5.30	Moderate	4.48	Moderate	6.10	4.81
Waterbird Feeding Habitat (WBF)	5.60	Moderate	2.50	Moderate	4.46	2.50
Waterbird Nesting Habitat (WBN)	3.62	Moderate	2.50	Moderate	3.09	2.50
Songbird, Raptor, & Mammal Habitat (SBM)	9.01	Higher	2.50	Lower	7.47	2.50
Pollinator Habitat (POL)	8.72	Higher	0.00	Lower	7.02	0.00
Native Plant Habitat (PH)	5.72	Moderate	5.56	Moderate	5.39	4.83
Public Use & Recognition (PU)			1.92	Lower		1.70
Wetland Sensitivity (Sens)			1.91	Lower		2.78
Wetland Ecological Condition (EC)			7.83	Higher		8.75
Wetland Stressors (STR) (higher score means more stress)			5.31	Higher		4.21
Summary Ratings for Grouped Functions:						

New Brunswick Reference Scores

Min	Max	Range	F_JenksLo	F_JenksHigh	Min	Max	Range	B_JenksLo	B_JenksHigh
1.73	9.42	7.68	2.48	5.12	0.08	10.00	9.92	2.58	5.67
0.00	5.33	5.33	2.92	6.56	0.00	5.83	5.83	2.08	6.16
0.00	6.67	6.67	1.80	5.30	0.00	6.02	6.02	1.45	4.79
3.16	10.00	6.84	1.76	5.26	0.00	6.07	6.07	3.75	7.95
2.90	10.00	7.10	2.66	4.17	0.33	9.38	9.04	1.71	4.55
3.83	10.00	6.17	2.27	4.36	1.11	10.00	8.89	2.50	7.19
4.56	8.88	4.31	3.13	5.70					
2.33	7.64	5.30	3.12	5.26					
0.00	6.13	6.13	1.80	6.71	0.00	7.39	7.39	0.00	4.44
0.00	5.95	5.95	1.40	6.29	0.00	7.09	7.09	0.00	4.48
3.87	7.39	3.52	2.58	5.58	1.24	6.64	5.39	0.85	5.74
3.30	8.58	5.28	3.30	6.25	2.09	8.16	6.06	2.27	6.30
0.00	7.96	7.96	0.00	6.84	0.00	10.00	10.00	0.83	6.67
0.00	8.54	8.54	1.95	5.42	0.00	10.00	10.00	0.00	6.67
0.00	8.29	8.29	2.50	7.24	0.00	10.00	10.00	3.33	6.67
0.00	8.05	8.05	0.00	7.81	0.00	10.00	10.00	0.00	6.67
3.08	7.12	4.03	3.96	5.98	0.00	8.68	8.68	0.00	6.33
					0.33	7.44	7.11	2.40	5.51
					2.20	5.20	2.99	2.88	5.30
					4.24	10.00	5.76	3.25	6.39
					2.26	5.93	3.67	2.15	4.97

Wetland #8

Size: Area delineated is 0.93 ha.

Wetland Classification: Treed Swamp

Dominant Wetland Vegetation (per 50/20 rule):

>50% Hydrophytic Vegetation?: Yes

- *Trees*: 10% northern white cedar (*Thuja occidentalis*, FACW); 10% red maple (FAC); 5% balsam fir (*Abies balsamea*, FAC); 5% black spruce (FACW); and 5% eastern larch (FAC).
- *Shrub:* 15% speckled alder (FACW); and 5% false holly (FAC);
- *Herb:* 15% jewelweed (*Impatiens capensis*, FAC); 10% cinnamon fern (FAC); 10% interrupted fern (FAC); 5% slender manna-grass (OBL); 5% Canada manna-grass (*Glyceria canadensis*, OBL); and 5% sensitive fern (*Onoclea sensibilis*, FACW).

Primary Wetland Hydrology Indicators Present: Surface Water (A1); High Water Table (A2); Saturation (A3); Water Stained Leaves (B9); and Aquatic Fauna (B13).

Secondary Wetland Hydrology Indicators Present: Drainage Patterns (B10).

Soil Profile:

- 2-0" organics (muck);
- 0-8" 7.5YR 2.5/1 (100%);
- Restrictive layer: bedrock.
- Hydric Soil Indicators: Very Shallow Dark Surface (TF12).

Notes:

- Position: Terrene;
- Landform: Slope;
- Water Flow Path: Outflow;
- Water Regime: Seasonally flooded; permanently saturated;
- Wetland Origin: Natural;
- Wetland Soils: Mineral;
- Human Impact: Tree removal, soil compaction/rutting.

Cover Page: Basic Description of Assessment	**WESP-AC version 2**
Site Name:	WL #8
Investigator Name:	CK
Date of Field Assessment:	Aug 16th, 2018
Nearest Town:	Upham
Latitude (decimal degrees):	
Longitude (decimal degrees):	
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	
What percent (approx.) of the **wetland** were you able to visit?	
What percent (approx.) of the **AA** were you able to visit?	
Were you able to ask the site owner/manager about any of the questions?	The site was logged ~ Aug 2010
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	Sept 2016
How many wetlands have you assessed previously using WESP-AC? (approx.)	>100
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

Assessment Area (AA) Results:

Wetland ID:

Date:

Observer:

Latitude & Longitude (decimal degrees):

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)	3.16	Moderate	4.40	Moderate	4.16	4.45
Stream Flow Support (SFS)	1.77	Lower	0.00	Lower	0.94	0.00
Water Cooling (WC)	5.25	Moderate	2.82	Moderate	3.50	1.70
Sediment Retention & Stabilisation (SR)	1.37	Lower	8.16	Higher	4.09	4.95
Phosphorus Retention (PR)	2.22	Lower	7.47	Higher	4.47	7.08
Nitrate Removal & Retention (NR)	1.54	Lower	10.00	Higher	4.78	10.00
Carbon Sequestration (CS)	2.17	Lower			5.50	
Organic Nutrient Export (OE)	5.67	Higher			5.34	
Anadromous Fish Habitat (FA)	4.78	Moderate	3.13	Moderate	2.93	2.31
Resident Fish Habitat (FR)	5.47	Moderate	2.98	Moderate	3.26	2.11
Aquatic Invertebrate Habitat (INV)	2.85	Moderate	6.15	Higher	4.88	4.56
Amphibian & Turtle Habitat (AM)	5.83	Moderate	4.89	Moderate	6.38	5.06
Waterbird Feeding Habitat (WBF)	5.74	Moderate	2.50	Moderate	4.57	2.50
Waterbird Nesting Habitat (WBN)	3.46	Moderate	2.50	Moderate	2.95	2.50
Songbird, Raptor, & Mammal Habitat (SBM)	8.77	Higher	3.33	Moderate	7.27	3.33
Pollinator Habitat (POL)	8.99	Higher	3.33	Moderate	7.24	3.33
Native Plant Habitat (PH)	6.46	Higher	6.85	Higher	5.69	5.95
Public Use & Recognition (PU)			3.48	Moderate		2.81
Wetland Sensitivity (Sens)			1.50	Lower		2.65
Wetland Ecological Condition (EC)			8.55	Higher		9.17
Wetland Stressors (STR) (higher score means more stress)			6.36	Higher		4.60
Summary Ratings for Grouped Functions:						

New Brunswick Reference Scores

Min	Max	Range	F_JenksLo	F_JenksHigh	Min	Max	Range	B_JenksLo	B_JenksHigh
1.73	9.42	7.68	2.48	5.12	0.08	10.00	9.92	2.58	5.67
0.00	5.33	5.33	2.92	6.56	0.00	5.83	5.83	2.08	6.16
0.00	6.67	6.67	1.80	5.30	0.00	6.02	6.02	1.45	4.79
3.16	10.00	6.84	1.76	5.26	0.00	6.07	6.07	3.75	7.95
2.90	10.00	7.10	2.66	4.17	0.33	9.38	9.04	1.71	4.55
3.83	10.00	6.17	2.27	4.36	1.11	10.00	8.89	2.50	7.19
4.56	8.88	4.31	3.13	5.70					
2.33	7.64	5.30	3.12	5.26					
0.00	6.13	6.13	1.80	6.71	0.00	7.39	7.39	0.00	4.44
0.00	5.95	5.95	1.40	6.29	0.00	7.09	7.09	0.00	4.48
3.87	7.39	3.52	2.58	5.58	1.24	6.64	5.39	0.85	5.74
3.30	8.58	5.28	3.30	6.25	2.09	8.16	6.06	2.27	6.30
0.00	7.96	7.96	0.00	6.84	0.00	10.00	10.00	0.83	6.67
0.00	8.54	8.54	1.95	5.42	0.00	10.00	10.00	0.00	6.67
0.00	8.29	8.29	2.50	7.24	0.00	10.00	10.00	3.33	6.67
0.00	8.05	8.05	0.00	7.81	0.00	10.00	10.00	0.00	6.67
3.08	7.12	4.03	3.96	5.98	0.00	8.68	8.68	0.00	6.33
					0.33	7.44	7.11	2.40	5.51
					2.20	5.20	2.99	2.88	5.30
					4.24	10.00	5.76	3.25	6.39
					2.26	5.93	3.67	2.15	4.97

Wetland #9

Size: Area delineated is 0.19 ha (wetland area extends beyond Project Area).

Wetland Classification: Treed Swamp

Dominant Wetland Vegetation (per 50/20 rule):

>50% Hydrophytic Vegetation?: Yes

- *Trees*: 20% northern white cedar (FACW); 20% red maple (FAC); and 10% balsam fir (FAC).
- *Shrub:* 25% speckled alder (FACW); and 5% red maple (FAC);
- *Herb:* 20% cinnamon fern (FAC); 15% bluejoint reed grass (*Calamagrostis canadensis*, FACW); 10% interrupted fern (FAC); 5% slender manna-grass (OBL); 5% Canada manna-grass (*Glyceria canadensis*, OBL); and 5% prickly sedge (*Carex echinata*, OBL).

Primary Wetland Hydrology Indicators Present: Surface Water (A1); High Water Table (A2); Saturation (A3); Water Stained Leaves (B9); and Aquatic Fauna (B13).

Secondary Wetland Hydrology Indicators Present: Drainage Patterns (B10).

Soil Profile:

- 12-0" organics (muck);
- 0-6" 2.5YR 2.5/1 (100%);
- 6-9" Gley 1 4/5G_/1 (100%);
- 9-12" 10R 4/6 (100%);
- Restrictive layer: gravels.
- Hydric Soil Indicators: Loamy Gleyed Matrix (F2).

Notes:

- Position: Terrene;
- Landform: Slope;
- Water Flow Path: Outflow;
- Water Regime: Seasonally flooded; permanently saturated;
- Wetland Origin: Natural;
- Wetland Soils: Mineral;
- Human Impact: Adjacent tree removal, soil compaction/rutting.

Cover Page: Basic Description of Assessment	**WESP-AC version 2**
Site Name:	WL #9
Investigator Name:	CK
Date of Field Assessment:	Aug 16th, 2018
Nearest Town:	Upham
Latitude (decimal degrees):	
Longitude (decimal degrees):	
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	
What percent (approx.) of the **wetland** were you able to visit?	
What percent (approx.) of the **AA** were you able to visit?	
Were you able to ask the site owner/manager about any of the questions?	The site was logged ~Aug 2010
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	Sept 2016
How many wetlands have you assessed previously using WESP-AC? (approx.)	>100
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

Assessment Area (AA) Results:

Wetland ID:

Date:

Observer:

Latitude & Longitude (decimal degrees):

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)	3.26	Moderate	3.19	Moderate	4.24	3.25
Stream Flow Support (SFS)	2.71	Lower	5.97	Moderate	1.44	3.48
Water Cooling (WC)	4.75	Moderate	2.51	Moderate	3.17	1.51
Sediment Retention & Stabilisation (SR)	1.42	Lower	7.50	Moderate	4.13	4.56
Phosphorus Retention (PR)	1.80	Lower	6.93	Higher	4.18	6.60
Nitrate Removal & Retention (NR)	1.79	Lower	10.00	Higher	4.94	10.00
Carbon Sequestration (CS)	2.60	Lower			5.68	
Organic Nutrient Export (OE)	5.17	Moderate			5.08	
Anadromous Fish Habitat (FA)	4.82	Moderate	3.17	Moderate	2.95	2.34
Resident Fish Habitat (FR)	5.79	Moderate	3.02	Moderate	3.45	2.14
Aquatic Invertebrate Habitat (INV)	4.60	Moderate	6.36	Higher	5.49	4.67
Amphibian & Turtle Habitat (AM)	6.02	Moderate	4.63	Moderate	6.48	4.90
Waterbird Feeding Habitat (WBF)	5.91	Moderate	2.50	Moderate	4.70	2.50
Waterbird Nesting Habitat (WBN)	3.45	Moderate	2.50	Moderate	2.94	2.50
Songbird, Raptor, & Mammal Habitat (SBM)	9.05	Higher	2.50	Lower	7.51	2.50
Pollinator Habitat (POL)	8.24	Higher	0.00	Lower	6.63	0.00
Native Plant Habitat (PH)	6.95	Higher	5.43	Moderate	5.89	4.71
Public Use & Recognition (PU)			1.92	Lower		1.70
Wetland Sensitivity (Sens)			2.22	Lower		2.87
Wetland Ecological Condition (EC)			10.00	Higher		10.00
Wetland Stressors (STR) (higher score means more stress)			8.05	Higher		5.22
Summary Ratings for Grouped Functions:						

New Brunswick Reference Scores

Min	Max	Range	F_JenksLo	F_JenksHigh	Min	Max	Range	B_JenksLo	B_JenksHigh
1.73	9.42	7.68	2.48	5.12	0.08	10.00	9.92	2.58	5.67
0.00	5.33	5.33	2.92	6.56	0.00	5.83	5.83	2.08	6.16
0.00	6.67	6.67	1.80	5.30	0.00	6.02	6.02	1.45	4.79
3.16	10.00	6.84	1.76	5.26	0.00	6.07	6.07	3.75	7.95
2.90	10.00	7.10	2.66	4.17	0.33	9.38	9.04	1.71	4.55
3.83	10.00	6.17	2.27	4.36	1.11	10.00	8.89	2.50	7.19
4.56	8.88	4.31	3.13	5.70					
2.33	7.64	5.30	3.12	5.26					
0.00	6.13	6.13	1.80	6.71	0.00	7.39	7.39	0.00	4.44
0.00	5.95	5.95	1.40	6.29	0.00	7.09	7.09	0.00	4.48
3.87	7.39	3.52	2.58	5.58	1.24	6.64	5.39	0.85	5.74
3.30	8.58	5.28	3.30	6.25	2.09	8.16	6.06	2.27	6.30
0.00	7.96	7.96	0.00	6.84	0.00	10.00	10.00	0.83	6.67
0.00	8.54	8.54	1.95	5.42	0.00	10.00	10.00	0.00	6.67
0.00	8.29	8.29	2.50	7.24	0.00	10.00	10.00	3.33	6.67
0.00	8.05	8.05	0.00	7.81	0.00	10.00	10.00	0.00	6.67
3.08	7.12	4.03	3.96	5.98	0.00	8.68	8.68	0.00	6.33
					0.33	7.44	7.11	2.40	5.51
					2.20	5.20	2.99	2.88	5.30
					4.24	10.00	5.76	3.25	6.39
					2.26	5.93	3.67	2.15	4.97

Wetland #10

Size: Area delineated is 0.10 ha.

Wetland Classification: Shrub Swamp

Dominant Wetland Vegetation (per 50/20 rule):

>50% Hydrophytic Vegetation?: Yes

- *Trees*: None (harvested in 2010).
- *Shrub:* 15% false holly (FAC); 15% sheep laurel (FAC); 10% steeplebush (FAC); and 10% red maple (FAC).
- *Herb:* 50% woolgrass (FACW); 15% soft rush (*Juncus effusus*, FACW).

Primary Wetland Hydrology Indicators Present: High Water Table (A2); and Saturation (A3).

Secondary Wetland Hydrology Indicators Present: Geomorphic Position (D2).

Soil Profile:

- 7-0" organics (muck);
- 0-4" 7.5YR 3/1 (100%);
- 4-7" 10YR 5/1 (100%);
- Restrictive layer: bedrock.
- Hydric Soil Indicators: Stratified Layers (A5).

Notes:

- Position: Terrene;
- Landform: Slope;
- Water Flow Path: Outflow;
- Water Regime: Seasonally flooded; permanently saturated;
- Wetland Origin: Unknown, possible result of tree removal and soil compaction;
- Wetland Soils: Mineral;
- Human Impact: Tree removal, soil compaction/rutting.

Cover Page: Basic Description of Assessment	**WESP-AC version 2**
Site Name:	WL #10
Investigator Name:	CK
Date of Field Assessment:	Aug 16th, 2018
Nearest Town:	Upham
Latitude (decimal degrees):	
Longitude (decimal degrees):	
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	
What percent (approx.) of the **wetland** were you able to visit?	
What percent (approx.) of the **AA** were you able to visit?	
Were you able to ask the site owner/manager about any of the questions?	The site was logged ~Aug 2010
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	Sept 2016
How many wetlands have you assessed previously using WESP-AC? (approx.)	>100
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

Assessment Area (AA) Results:

Wetland ID:

Date:

Observer:

Latitude & Longitude (decimal degrees):

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)	5.16	Higher	1.93	Lower	5.70	2.00
Stream Flow Support (SFS)	1.67	Lower	0.00	Lower	0.89	0.00
Water Cooling (WC)	0.00	Lower	0.00	Lower	0.00	0.00
Sediment Retention & Stabilisation (SR)	4.18	Moderate	2.21	Lower	6.02	1.34
Phosphorus Retention (PR)	1.76	Lower	1.47	Lower	4.15	1.67
Nitrate Removal & Retention (NR)	1.52	Lower	4.38	Moderate	4.77	5.00
Carbon Sequestration (CS)	2.56	Lower			5.66	
Organic Nutrient Export (OE)	3.62	Moderate			4.25	
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)	5.23	Moderate	0.67	Lower	5.71	1.60
Amphibian & Turtle Habitat (AM)	3.06	Lower	0.51	Lower	4.92	2.40
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)	5.68	Moderate	2.50	Lower	4.71	2.50
Pollinator Habitat (POL)	4.97	Moderate	0.00	Lower	4.00	0.00
Native Plant Habitat (PH)	2.69	Lower	3.35	Moderate	4.17	2.90
Public Use & Recognition (PU)			1.92	Lower		1.70
Wetland Sensitivity (Sens)			1.87	Lower		2.76
Wetland Ecological Condition (EC)			3.49	Moderate		6.25
Wetland Stressors (STR) (higher score means more stress)			9.57	Higher		5.78
Summary Ratings for Grouped Functions:						

New Brunswick Reference Scores

Min	Max	Range	F_JenksLo	F_JenksHigh	Min	Max	Range	B_JenksLo	B_JenksHigh
1.73	9.42	7.68	2.48	5.12	0.08	10.00	9.92	2.58	5.67
0.00	5.33	5.33	2.92	6.56	0.00	5.83	5.83	2.08	6.16
0.00	6.67	6.67	1.80	5.30	0.00	6.02	6.02	1.45	4.79
3.16	10.00	6.84	1.76	5.26	0.00	6.07	6.07	3.75	7.95
2.90	10.00	7.10	2.66	4.17	0.33	9.38	9.04	1.71	4.55
3.83	10.00	6.17	2.27	4.36	1.11	10.00	8.89	2.50	7.19
4.56	8.88	4.31	3.13	5.70					
2.33	7.64	5.30	3.12	5.26					
0.00	6.13	6.13	1.80	6.71	0.00	7.39	7.39	0.00	4.44
0.00	5.95	5.95	1.40	6.29	0.00	7.09	7.09	0.00	4.48
3.87	7.39	3.52	2.58	5.58	1.24	6.64	5.39	0.85	5.74
3.30	8.58	5.28	3.30	6.25	2.09	8.16	6.06	2.27	6.30
0.00	7.96	7.96	0.00	6.84	0.00	10.00	10.00	0.83	6.67
0.00	8.54	8.54	1.95	5.42	0.00	10.00	10.00	0.00	6.67
0.00	8.29	8.29	2.50	7.24	0.00	10.00	10.00	3.33	6.67
0.00	8.05	8.05	0.00	7.81	0.00	10.00	10.00	0.00	6.67
3.08	7.12	4.03	3.96	5.98	0.00	8.68	8.68	0.00	6.33
					0.33	7.44	7.11	2.40	5.51
					2.20	5.20	2.99	2.88	5.30
					4.24	10.00	5.76	3.25	6.39
					2.26	5.93	3.67	2.15	4.97

Wetland #11

Size: Area delineated is 0.31 ha.

Wetland Classification: Shrub Swamp/ Wet Meadow

Dominant Wetland Vegetation (per 50/20 rule):

>50% Hydrophytic Vegetation?: Yes

- *Trees*: None (harvested in 2010).
- *Shrub:* 15% white meadowsweet (FAC); 15% speckled alder (FACW); 10% willow spp. (*Salix* spp., FACW); and 5% bristly black currant (*Ribes lacustre*, FACW).
- *Herb:* 40% woolgrass (FACW); 15% soft rush (*Juncus effusus*, FACW); 5% spotted Joe-Pye weed (FACW); and 5% marsh willow-herb (*Epilobium palustre*, OBL).

Primary Wetland Hydrology Indicators Present: High Water Table (A2); and Saturation (A3).

Secondary Wetland Hydrology Indicators Present: Geomorphic Position (D2).

Soil Profile:

- 5-0" organics (muck);
- 0-6" 7.5YR 3/2 (100%);
- 6-10" 7.5YR 4/1 (100%);
- Restrictive layer: bedrock.
- Hydric Soil Indicators: Stratified Layers (A5).

Notes:

- Position: Terrene;
- Landform: Slope;
- Water Flow Path: Outflow;
- Water Regime: Seasonally flooded; permanently saturated;
- Wetland Origin: Unknown, possible result of tree removal and soil compaction;
- Wetland Soils: Mineral;
- Human Impact: Tree removal, soil compaction/rutting.

Cover Page: Basic Description of Assessment	**WESP-AC version 2**
Site Name:	WL #11
Investigator Name:	CK
Date of Field Assessment:	Aug 16th, 2018
Nearest Town:	Upham
Latitude (decimal degrees):	
Longitude (decimal degrees):	
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	
What percent (approx.) of the **wetland** were you able to visit?	
What percent (approx.) of the **AA** were you able to visit?	
Were you able to ask the site owner/manager about any of the questions?	The site was logged ~Aug 2010
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	Sept 2016
How many wetlands have you assessed previously using WESP-AC? (approx.)	>100
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

Assessment Area (AA) Results:

Wetland ID:

Date:

Observer:

Latitude & Longitude (decimal degrees):

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)	3.94	Moderate	1.91	Lower	4.76	1.98
Stream Flow Support (SFS)	3.28	Moderate	3.94	Moderate	1.75	2.30
Water Cooling (WC)	0.00	Lower	0.00	Lower	0.00	0.00
Sediment Retention & Stabilisation (SR)	4.32	Moderate	2.06	Lower	6.11	1.25
Phosphorus Retention (PR)	2.02	Lower	1.24	Lower	4.33	1.46
Nitrate Removal & Retention (NR)	0.78	Lower	4.38	Moderate	4.32	5.00
Carbon Sequestration (CS)	3.85	Moderate			6.22	
Organic Nutrient Export (OE)	4.33	Moderate			4.63	
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	0.81	Lower	5.08	1.68
Amphibian & Turtle Habitat (AM)	3.14	Lower	0.74	Lower	4.96	2.54
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)	6.18	Moderate	2.50	Lower	5.13	2.50
Pollinator Habitat (POL)	6.27	Moderate	0.00	Lower	5.05	0.00
Native Plant Habitat (PH)	3.37	Lower	3.91	Moderate	4.44	3.39
Public Use & Recognition (PU)			1.92	Lower		1.70
Wetland Sensitivity (Sens)			3.16	Moderate		3.15
Wetland Ecological Condition (EC)			3.49	Moderate		6.25
Wetland Stressors (STR) (higher score means more stress)			8.15	Higher		5.25
Summary Ratings for Grouped Functions:						

New Brunswick Reference Scores

Min	Max	Range	F_JenksLo	F_JenksHigh	Min	Max	Range	B_JenksLo	B_JenksHigh
1.73	9.42	7.68	2.48	5.12	0.08	10.00	9.92	2.58	5.67
0.00	5.33	5.33	2.92	6.56	0.00	5.83	5.83	2.08	6.16
0.00	6.67	6.67	1.80	5.30	0.00	6.02	6.02	1.45	4.79
3.16	10.00	6.84	1.76	5.26	0.00	6.07	6.07	3.75	7.95
2.90	10.00	7.10	2.66	4.17	0.33	9.38	9.04	1.71	4.55
3.83	10.00	6.17	2.27	4.36	1.11	10.00	8.89	2.50	7.19
4.56	8.88	4.31	3.13	5.70					
2.33	7.64	5.30	3.12	5.26					
0.00	6.13	6.13	1.80	6.71	0.00	7.39	7.39	0.00	4.44
0.00	5.95	5.95	1.40	6.29	0.00	7.09	7.09	0.00	4.48
3.87	7.39	3.52	2.58	5.58	1.24	6.64	5.39	0.85	5.74
3.30	8.58	5.28	3.30	6.25	2.09	8.16	6.06	2.27	6.30
0.00	7.96	7.96	0.00	6.84	0.00	10.00	10.00	0.83	6.67
0.00	8.54	8.54	1.95	5.42	0.00	10.00	10.00	0.00	6.67
0.00	8.29	8.29	2.50	7.24	0.00	10.00	10.00	3.33	6.67
0.00	8.05	8.05	0.00	7.81	0.00	10.00	10.00	0.00	6.67
3.08	7.12	4.03	3.96	5.98	0.00	8.68	8.68	0.00	6.33
					0.33	7.44	7.11	2.40	5.51
					2.20	5.20	2.99	2.88	5.30
					4.24	10.00	5.76	3.25	6.39
					2.26	5.93	3.67	2.15	4.97

Wetland #12

Size: Area delineated is 0.08 ha (wetland area extends beyond Project Area).

Wetland Classification: Shrub Swamp

Dominant Wetland Vegetation (per 50/20 rule):

>50% Hydrophytic Vegetation?: Yes

- *Trees*: None.
- *Shrub:* 70% speckled alder (FACW); 5% false holly (FAC); 5% wild raisin (FAC); and 5% white meadowsweet (FAC)
- *Herb:* 20% slender manna-grass (OBL); 15% small floating manna-grass (*Glyceria borealis*, OBL); 15% sensitive fern (FACW); and 5% arrow-leaved tearthumb (*Polygonum sagittatum*, OBL).

Primary Wetland Hydrology Indicators Present: Surface Water (A1); High Water Table (A2); Saturation (A3); Water-stained Leaves (B9); and Aquatic Fauna (B13).

Secondary Wetland Hydrology Indicators Present: Drainage Patterns (B10).

Soil Profile:

- 0-16" 7.5YR 2.5/1 (100%) (muck);
- 16-24" 10YR 3/1 (100%);
- 24+" Gley 2 4/10BG (100%);
- Restrictive layer: unknown.
- Hydric Soil Indicators: Stratified Layers (A5); and Loamy Gleyed Matrix (F2).

Notes:

- Position: Lentic Stream;
- Landform: Basin;
- Water Flow Path: Throughflow;
- Water Regime: Seasonally flooded; permanently saturated;
- Wetland Origin: Natural;
- Wetland Soils: Mineral;
- Human Impact: nearby tree removal and soil compaction/rutting.

Cover Page: Basic Description of Assessment	**WESP-AC version 2**
Site Name:	WL #12
Investigator Name:	CK
Date of Field Assessment:	Aug 16th, 2018
Nearest Town:	Upham
Latitude (decimal degrees):	
Longitude (decimal degrees):	
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	
What percent (approx.) of the **wetland** were you able to visit?	
What percent (approx.) of the **AA** were you able to visit?	
Were you able to ask the site owner/manager about any of the questions?	The site was logged ~Aug 2010
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	Sept 2016
How many wetlands have you assessed previously using WESP-AC? (approx.)	>100
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

Assessment Area (AA) Results:

Wetland ID:

Date:

Observer:

Latitude & Longitude (decimal degrees):

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)	3.92	Moderate	1.91	Lower	4.75	1.98
Stream Flow Support (SFS)	2.92	Lower	6.00	Moderate	1.56	3.50
Water Cooling (WC)	3.75	Moderate	2.58	Moderate	2.50	1.55
Sediment Retention & Stabilisation (SR)	2.38	Moderate	7.24	Moderate	4.78	4.40
Phosphorus Retention (PR)	2.44	Lower	6.54	Higher	4.63	6.25
Nitrate Removal & Retention (NR)	2.81	Moderate	10.00	Higher	5.57	10.00
Carbon Sequestration (CS)	3.99	Moderate			6.29	
Organic Nutrient Export (OE)	6.30	Higher			5.68	
Anadromous Fish Habitat (FA)	5.19	Moderate	3.19	Moderate	3.18	2.36
Resident Fish Habitat (FR)	6.42	Higher	3.05	Moderate	3.82	2.16
Aquatic Invertebrate Habitat (INV)	4.05	Moderate	6.52	Higher	5.30	4.76
Amphibian & Turtle Habitat (AM)	6.14	Moderate	4.44	Moderate	6.54	4.79
Waterbird Feeding Habitat (WBF)	6.04	Moderate	2.50	Moderate	4.81	2.50
Waterbird Nesting Habitat (WBN)	3.68	Moderate	2.50	Moderate	3.15	2.50
Songbird, Raptor, & Mammal Habitat (SBM)	8.51	Higher	2.50	Lower	7.05	2.50
Pollinator Habitat (POL)	8.94	Higher	0.00	Lower	7.20	0.00
Native Plant Habitat (PH)	5.37	Moderate	5.48	Moderate	5.25	4.75
Public Use & Recognition (PU)			1.92	Lower		1.70
Wetland Sensitivity (Sens)			2.29	Lower		2.89
Wetland Ecological Condition (EC)			8.55	Higher		9.17
Wetland Stressors (STR) (higher score means more stress)			5.60	Higher		4.32
Summary Ratings for Grouped Functions:						

New Brunswick Reference Scores

Min	Max	Range	F_JenksLo	F_JenksHigh	Min	Max	Range	B_JenksLo	B_JenksHigh
1.73	9.42	7.68	2.48	5.12	0.08	10.00	9.92	2.58	5.67
0.00	5.33	5.33	2.92	6.56	0.00	5.83	5.83	2.08	6.16
0.00	6.67	6.67	1.80	5.30	0.00	6.02	6.02	1.45	4.79
3.16	10.00	6.84	1.76	5.26	0.00	6.07	6.07	3.75	7.95
2.90	10.00	7.10	2.66	4.17	0.33	9.38	9.04	1.71	4.55
3.83	10.00	6.17	2.27	4.36	1.11	10.00	8.89	2.50	7.19
4.56	8.88	4.31	3.13	5.70					
2.33	7.64	5.30	3.12	5.26					
0.00	6.13	6.13	1.80	6.71	0.00	7.39	7.39	0.00	4.44
0.00	5.95	5.95	1.40	6.29	0.00	7.09	7.09	0.00	4.48
3.87	7.39	3.52	2.58	5.58	1.24	6.64	5.39	0.85	5.74
3.30	8.58	5.28	3.30	6.25	2.09	8.16	6.06	2.27	6.30
0.00	7.96	7.96	0.00	6.84	0.00	10.00	10.00	0.83	6.67
0.00	8.54	8.54	1.95	5.42	0.00	10.00	10.00	0.00	6.67
0.00	8.29	8.29	2.50	7.24	0.00	10.00	10.00	3.33	6.67
0.00	8.05	8.05	0.00	7.81	0.00	10.00	10.00	0.00	6.67
3.08	7.12	4.03	3.96	5.98	0.00	8.68	8.68	0.00	6.33
					0.33	7.44	7.11	2.40	5.51
					2.20	5.20	2.99	2.88	5.30
					4.24	10.00	5.76	3.25	6.39
					2.26	5.93	3.67	2.15	4.97

Wetland #13

Size: Area delineated is 0.27 ha.

Wetland Classification: Wet Meadow

Dominant Wetland Vegetation (per 50/20 rule):

>50% Hydrophytic Vegetation?: Yes

- *Trees*: None (harvested in 2010).
- *Shrub:* 15% white meadowsweet (FAC); 10% steeplebush (FAC); 10% speckled alder (FACW); and 5% red raspberry (*Rubus idaeus*, FAC).
- *Herb:* 40% woolgrass (FACW); 20% narrow-leaved cattail (OBL); 10% sensitive fern (FACW); 5% nodding sedge (*Carex gynandra*, FACW); and 2% arrow-leaved tearthumb (OBL).

Primary Wetland Hydrology Indicators Present: Surface Water (A1); High Water Table (A2); Saturation (A3); and Aquatic Fauna (B13).

Secondary Wetland Hydrology Indicators Present: None.

Soil Profile:

- 5-0" organics (muck);
- 0-8" 7.5YR 4/2 (100%);
- 8-13" 5YR 3/1 (100%);
- Restrictive layer: unknown.
- Hydric Soil Indicators: Stratified Layers (A5).

Notes:

- Position: Terrene;
- Landform: Slope;
- Water Flow Path: Outflow;
- Water Regime: Seasonally flooded; permanently saturated;
- Wetland Origin: Unknown, possible result of tree removal and soil compaction;
- Wetland Soils: Mineral;
- Human Impact: nearby tree removal and soil compaction/rutting.

Cover Page: Basic Description of Assessment	**WESP-AC version 2**
Site Name:	WL #13
Investigator Name:	CK
Date of Field Assessment:	Aug 16th, 2018
Nearest Town:	Upham
Latitude (decimal degrees):	
Longitude (decimal degrees):	
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	
What percent (approx.) of the **wetland** were you able to visit?	
What percent (approx.) of the **AA** were you able to visit?	
Were you able to ask the site owner/manager about any of the questions?	The site was logged ~Aug 2010
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	Sept 2016
How many wetlands have you assessed previously using WESP-AC? (approx.)	>100
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

Assessment Area (AA) Results:

Wetland ID:

Date:

Observer:

Latitude & Longitude (decimal degrees):

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)	2.73	Moderate	1.98	Lower	3.83	2.05
Stream Flow Support (SFS)	2.92	Lower	4.06	Moderate	1.56	2.37
Water Cooling (WC)	2.40	Moderate	1.10	Lower	1.60	0.66
Sediment Retention & Stabilisation (SR)	0.91	Lower	1.95	Lower	3.78	1.18
Phosphorus Retention (PR)	2.84	Moderate	1.17	Lower	4.92	1.39
Nitrate Removal & Retention (NR)	0.00	Lower	3.63	Moderate	3.80	4.33
Carbon Sequestration (CS)	1.76	Lower			5.32	
Organic Nutrient Export (OE)	5.09	Moderate			5.04	
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)	2.05	Lower	3.75	Moderate	4.59	3.27
Amphibian & Turtle Habitat (AM)	4.55	Moderate	3.81	Moderate	5.70	4.40
Waterbird Feeding Habitat (WBF)	5.97	Moderate	2.50	Moderate	4.75	2.50
Waterbird Nesting Habitat (WBN)	3.74	Moderate	2.50	Moderate	3.19	2.50
Songbird, Raptor, & Mammal Habitat (SBM)	7.18	Moderate	2.50	Lower	5.96	2.50
Pollinator Habitat (POL)	7.33	Moderate	0.00	Lower	5.90	0.00
Native Plant Habitat (PH)	3.50	Lower	4.55	Moderate	4.50	3.95
Public Use & Recognition (PU)			1.92	Lower		1.70
Wetland Sensitivity (Sens)			1.75	Lower		2.73
Wetland Ecological Condition (EC)			6.39	Moderate		7.92
Wetland Stressors (STR) (higher score means more stress)			9.76	Higher		5.84
Summary Ratings for Grouped Functions:						

New Brunswick Reference Scores

Min	Max	Range	F_JenksLo	F_JenksHigh	Min	Max	Range	B_JenksLo	B_JenksHigh
1.73	9.42	7.68	2.48	5.12	0.08	10.00	9.92	2.58	5.67
0.00	5.33	5.33	2.92	6.56	0.00	5.83	5.83	2.08	6.16
0.00	6.67	6.67	1.80	5.30	0.00	6.02	6.02	1.45	4.79
3.16	10.00	6.84	1.76	5.26	0.00	6.07	6.07	3.75	7.95
2.90	10.00	7.10	2.66	4.17	0.33	9.38	9.04	1.71	4.55
3.83	10.00	6.17	2.27	4.36	1.11	10.00	8.89	2.50	7.19
4.56	8.88	4.31	3.13	5.70					
2.33	7.64	5.30	3.12	5.26					
0.00	6.13	6.13	1.80	6.71	0.00	7.39	7.39	0.00	4.44
0.00	5.95	5.95	1.40	6.29	0.00	7.09	7.09	0.00	4.48
3.87	7.39	3.52	2.58	5.58	1.24	6.64	5.39	0.85	5.74
3.30	8.58	5.28	3.30	6.25	2.09	8.16	6.06	2.27	6.30
0.00	7.96	7.96	0.00	6.84	0.00	10.00	10.00	0.83	6.67
0.00	8.54	8.54	1.95	5.42	0.00	10.00	10.00	0.00	6.67
0.00	8.29	8.29	2.50	7.24	0.00	10.00	10.00	3.33	6.67
0.00	8.05	8.05	0.00	7.81	0.00	10.00	10.00	0.00	6.67
3.08	7.12	4.03	3.96	5.98	0.00	8.68	8.68	0.00	6.33
					0.33	7.44	7.11	2.40	5.51
					2.20	5.20	2.99	2.88	5.30
					4.24	10.00	5.76	3.25	6.39
					2.26	5.93	3.67	2.15	4.97

Appendix C

Vegetation Species Lists

Table C.1: Wetlands - Vegetation Species List - Proposed Gypsum Quarry, Upham East, New Brunswick

Scientific Name	Common name	Sub-National Status Rank	SGS Rank
Acer rubrum	Red Maple	S5	4 Secure
Acer spicatum	Mountain Maple	S5	4 Secure
Sium suave	Common Water Parsnip	S5	4 Secure
Ilex verticillata	Common Winterberry	S5	4 Secure
Nemopanthus mucronatus	Mountain Holly	S5	4 Secure
Bidens cernua	Nodding Beggarticks	S5	4 Secure
Doellingeria umbellata	Hairy Flat-top White Aster	S5	4 Secure
Eupatorium maculatum	Spotted Joe-pye-weed	S5	4 Secure
Euthamia graminifolia	Grass-leaved Goldenrod	S5	4 Secure
Oclemena nemoralis	Bog Aster	S5	4 Secure
Packera aurea	Golden Groundsel	S4S5	4 Secure
Solidago gigantea	Giant Goldenrod	S5	4 Secure
Solidago uliginosa	Northern Bog Goldenrod	S5	4 Secure
Tussilago farfara	Coltsfoot	SNA	7 Exotic
Impatiens capensis	Spotted Jewelweed	S5	4 Secure
Alnus incana	Speckled Alder	S5	4 Secure
Betula alleghaniensis	Yellow Birch	S5	4 Secure
Betula populifolia	Gray Birch	S5	4 Secure
Myosotis laxa	Small Forget-Me-Not	S5	4 Secure
Hypericum boreale	Northern St John's-Wort	S5	4 Secure
Hypericum canadense	Canada St John's-wort	S5	4 Secure
Hypericum ellipticum	Pale St John's-Wort	S5	4 Secure
Triadenum fraseri	Fraser's Marsh St John's-wort	S5	4 Secure
Cornus sericea	Red Osier Dogwood	S5	4 Secure
Linnaea borealis	Twinflower	S5	4 Secure
Sambucus racemosa	Red Elderberry	S5	4 Secure
Viburnum lantanoides	Hobblebush	S5	4 Secure
Viburnum nudum	Northern Wild Raisin	S5	4 Secure
Echinocystis lobata	Wild Cucumber	S5	4 Secure
Chamaedaphne calyculata	Leatherleaf	S5	4 Secure
Gaultheria hispidula	Creeping Snowberry	S5	4 Secure
Gaultheria procumbens	Eastern Teaberry	S5	4 Secure
Kalmia angustifolia	Sheep Laurel	S5	4 Secure
Ledum groenlandicum	Common Labrador Tea	S5	4 Secure
Rhododendron canadense	Rhodora	S5	4 Secure
Vaccinium angustifolium	Late Lowbush Blueberry	S5	4 Secure
Vaccinium macrocarpon	Large Cranberry	S5	4 Secure
Vaccinium myrtilloides	Velvet-leaved Blueberry	S5	4 Secure
Ribes lacustre	Bristly Black Currant	S5	4 Secure
Lycopus americanus	American Water Horehound	S5	4 Secure
Mentha arvensis	Wild Mint	S5	4 Secure
Scutellaria galericulata	Marsh Skullcap	S5	4 Secure
Scutellaria lateriflora	Mad-dog Skullcap	S5	4 Secure
Fraxinus americana	White Ash	S4S5	4 Secure
Epilobium ciliatum	Northern Willowherb	S5	4 Secure
Epilobium palustre	Marsh Willowherb	S5	4 Secure
Ludwigia palustris	Marsh Seedbox	S4	4 Secure
Polygonum hydropiperoides	False Waterpepper	S4	4 Secure
Polygonum sagittatum	Arrow-leaved Smartweed	S5	4 Secure
Rumex crispus	Curled Dock	SNA	7 Exotic
Rumex orbiculatus	Greater Water Dock	S5	4 Secure
Lysimachia terrestris	Swamp Yellow Loosestrife	S5	4 Secure
Clematis virginiana	Virginia Clematis	S5	4 Secure
Ranunculus acris	Common Buttercup	SNA	7 Exotic
Ranunculus recurvatus	Hooked Buttercup	S4	4 Secure
Ranunculus repens	Creeping Buttercup	SNA	7 Exotic
Thalictrum pubescens	Tall Meadow-Rue	S5	4 Secure
Fragaria virginiana	Wild Strawberry	S5	4 Secure
Geum canadense	White Avens	S5	4 Secure
Geum macrophyllum	Large-Leaved Avens	S5	4 Secure
Rubus allegheniensis	Alleghaney Blackberry	S5	4 Secure
Rubus hispidus	Bristly Dewberry	S5	4 Secure
Spiraea alba	White Meadowsweet	S5	4 Secure
Spiraea tomentosa	Steeplebush	S5	4 Secure
Galium palustre	Common Marsh Bedstraw	S5	4 Secure
Populus tremuloides	Trembling Aspen	S5	4 Secure
Salix spp.	Willow spp.	-	-
Chelone glabra	White Turtlehead	S5	4 Secure
Mimulus ringens	Square-stemmed Monkeyflower	S5	4 Secure
Veronica scutellata	Marsh Speedwell	S5	4 Secure
Viola spp.	Violet spp.	-	-

Table C.1: Wetlands - Vegetation Species List - Proposed Gypsum Quarry, Upham East, New Brunswick

Scientific Name	Common name	Sub-National Status Rank	SGS Rank
Thuja occidentalis	Eastern White Cedar	S5	4 Secure
Abies balsamea	Balsam Fir	S5	4 Secure
Larix laricina	Tamarack	S5	4 Secure
Picea mariana	Black Spruce	S5	4 Secure
Tsuga canadensis	Eastern Hemlock	S5	4 Secure
Calla palustris	Wild Calla	S5	4 Secure
Carex aquatilis	Water Sedge	S4S5	4 Secure
Carex castanea	Chestnut Sedge	S4	4 Secure
Carex disperma	Two-seeded Sedge	S5	4 Secure
Carex echinata	Star Sedge	S5	4 Secure
Carex gynandra	Nodding Sedge	S5	4 Secure
Carex lurida	Sallow Sedge	S5	4 Secure
Carex nigra	Smooth Black Sedge	S4S5	4 Secure
Carex pseudocyperus	Cyperuslike Sedge	S5	4 Secure
Carex scoparia	Broom Sedge	S5	4 Secure
Carex stipata	Awl-fruited Sedge	S5	4 Secure
Carex trisperma	Three-seeded Sedge	S5	4 Secure
Eleocharis palustris	Common Spikerush	S5	4 Secure
Eriophorum virginicum	Tawny Cottongrass	S5	4 Secure
Schoenoplectus tabernaemontani	Softstem Bulrush	S5	4 Secure
Scirpus atrocinctus	Black-girdled Bulrush	S5	4 Secure
Scirpus cyperinus	Common Woolly Bulrush	S5	4 Secure
Eriocaulon aquaticum	White Buttons	S5	4 Secure
Iris versicolor	Harlequin Blue Flag	S5	4 Secure
Juncus effusus	Soft Rush	S5	4 Secure
Spirodela polyrrhiza	Great Duckweed	S3S4	4 Secure
Maianthemum trifolium	Three-leaved False Soloman's Seal	S5	4 Secure
*Spiranthes spp.**	Spiranthes spp.	-	-
Calamagrostis canadensis	Bluejoint Reed Grass	S5	4 Secure
Glyceria borealis	Northern Manna Grass	S5	4 Secure
Glyceria canadensis	Canada Manna Grass	S5	4 Secure
Glyceria melicaria	Slender Manna Grass	S5	4 Secure
Phalaris arundinacea	Reed Canary Grass	S5	4 Secure
Sparganium americanum	American Burreed	S5	4 Secure
Typha latifolia	Broad-leaved Cattail	S5	4 Secure
Dryopteris carthusiana	Spinulose Wood Fern	S5	4 Secure
Dryopteris cristata	Crested Wood Fern	S5	4 Secure
Onoclea sensibilis	Sensitive Fern	S5	4 Secure
Osmunda cinnamomea	Cinnamon Fern	S5	4 Secure
Osmunda claytoniana	Interrupted Fern	S5	4 Secure
Thelypteris palustris	Eastern Marsh Fern	S5	4 Secure
Rorippa nasturtium-aquaticum	Watercress	SNA	7 Exotic
Carex scabrata	Rough Sedge	S5	4 Secure
Potamogeton spp.	Pondweed spp.	-	-

* Note: This speceis was unidentifiable during the field assessment. The habitat where the specimen was found was consistent with Shining Ladies Tresses (*Spiranthes lucid)* , an SOCC listed as an “Uncommon” (S3) species identified by the AC CDC.

Table C.2: Cut-over Areas - Vegetation Species List - Proposed Gypsum Quarry, Upham East, New Brunswick

Scientific Name	Common name	Sub-National Status Rank	SGS Rank
Nemopanthus mucronatus	Mountain Holly	S5	4 Secure
Aralia hispida	Bristly Sarsaparilla	S5	4 Secure
Aralia nudicaulis	Wild Sarsaparilla	S5	4 Secure
Centaurea nigra	Black Knapweed	SNA	7 Exotic
Doellingeria umbellata	Hairy Flat-top White Aster	S5	4 Secure
Euthamia graminifolia	Grass-leaved Goldenrod	S5	4 Secure
Prenanthes altissima	Tall Rattlesnakeroot	S5	4 Secure
Prenanthes trifoliolata	Three-leaved Rattlesnakeroot	S5	4 Secure
Solidago bicolor	White Goldenrod	S5	4 Secure
Solidago canadensis	Canada Goldenrod	S5	4 Secure
Solidago puberula	Downy Goldenrod	S5	4 Secure
Solidago rugosa	Rough-stemmed Goldenrod	S5	4 Secure
Tussilago farfara	Coltsfoot	SNA	7 Exotic
Betula papyrifera	Paper Birch	S5	4 Secure
Betula populifolia	Gray Birch	S5	4 Secure
Cornus canadensis	Bunchberry	S5	4 Secure
Viburnum nudum	Northern Wild Raisin	S5	4 Secure
Epigaea repens	Trailing Arbutus	S5	4 Secure
Kalmia angustifolia	Sheep Laurel	S5	4 Secure
Vaccinium angustifolium	Late Lowbush Blueberry	S5	4 Secure
Vaccinium myrtilloides	Velvet-leaved Blueberry	S5	4 Secure
Melilotus albus	White Sweet-clover	SNA	7 Exotic
Trifolium arvense	Rabbit's-foot Clover	SNA	7 Exotic
Trifolium aureum	Yellow Clover	SNA	7 Exotic
Trifolium pratense	Red Clover	SNA	7 Exotic
Trifolium repens	White Clover	SNA	7 Exotic
Ribes glandulosum	Skunk Currant	S5	4 Secure
Ribes hirtellum	Smooth Gooseberry	S5	4 Secure
Prunella vulgaris	Common Self-heal	S5	4 Secure
Chamerion angustifolium	Fireweed	S5	4 Secure
Rumex crispus	Curled Dock	SNA	7 Exotic
Plantago major	Common Plantain	SNA	7 Exotic
Trientalis borealis	Northern Starflower	S5	4 Secure
Fragaria virginiana	Wild Strawberry	S5	4 Secure
Prunus serotina	Black Cherry	S5	4 Secure
Prunus virginiana	Chokecherry	S5	4 Secure
Rubus allegheniensis	Alleghaney Blackberry	S5	4 Secure
Rubus idaeus	Red Raspberry	S5	4 Secure
Sorbus americana	American Mountain Ash	S5	4 Secure
Spiraea alba	White Meadowsweet	S5	4 Secure
Spiraea tomentosa	Steeplebush	S5	4 Secure
Populus tremuloides	Trembling Aspen	S5	4 Secure
Salix spp.	Willow Spp.	-	-
Euphrasia nemorosa	Common Eyebright	SNA	7 Exotic
Viola spp.	Violet spp.	-	-
Juniperus communis	Common Juniper	S5	4 Secure
Abies balsamea	Balsam Fir	S5	4 Secure
Pinus strobus	Eastern White Pine	S5	4 Secure
Carex projecta	Necklace Sedge	S5	4 Secure
Scirpus cyperinus	Common Woolly Bulrush	S5	4 Secure
Juncus effusus	Soft Rush	S5	4 Secure
Pteridium aquilinum	Bracken Fern	S5	4 Secure
Osmunda cinnamomea	Cinnamon Fern	S5	4 Secure

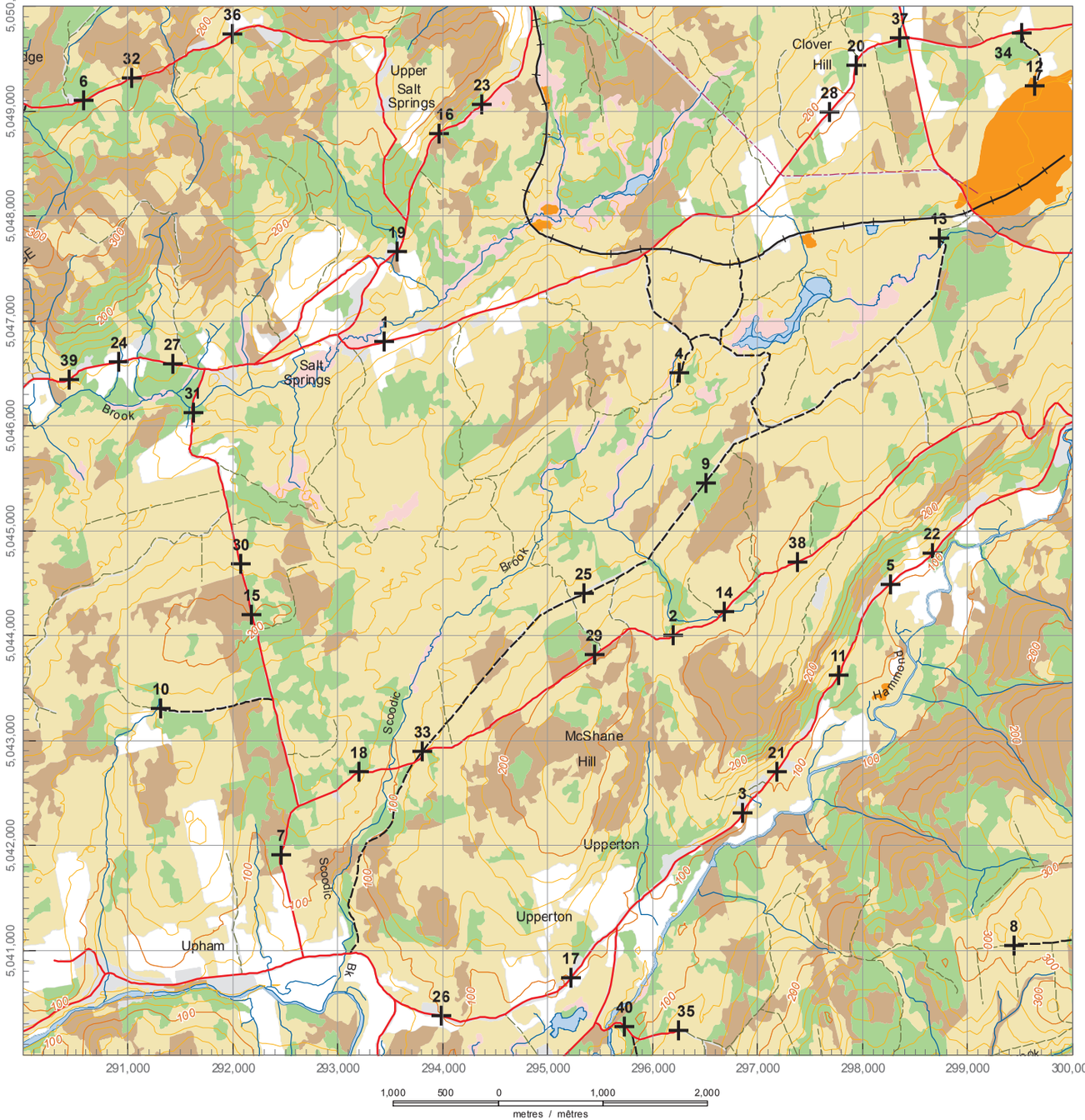
Table C.3: Cut-over Areas - Vegetation Species List - Proposed Gypsum Quarry, Upham East, New Brunswick

Scientific Name	Common name	Sub-National Status Rank	SGS Rank
Acer pensylvanicum	Striped Maple	S5	4 Secure
Acer saccharum	Sugar Maple	S5	4 Secure
Acer spicatum	Mountain Maple	S5	4 Secure
Sium suave	Common Water Parsnip	S5	4 Secure
Aralia nudicaulis	Wild Sarsaparilla	S5	4 Secure
Oclemena acuminata	Whorled Wood Aster	S5	4 Secure
Tussilago farfara	Coltsfoot	SNA	7 Exotic
Betula alleghaniensis	Yellow Birch	S5	4 Secure
Betula papyrifera	Paper Birch	S5	4 Secure
Hypericum perforatum	Common St. John's-wort	SNA	7 Exotic
Cornus canadensis	Bunchberry	S5	4 Secure
Lonicera canadensis	Canada Fly Honeysuckle	S5	4 Secure
Viburnum nudum	Northern Wild Raisin	S5	4 Secure
Epigaea repens	Trailing Arbutus	S5	4 Secure
Ribes glandulosum	Skunk Currant	S5	4 Secure
Monotropa uniflora	Indian Pipe	S5	4 Secure
Circaea alpina	Small Enchanter's Nightshade	S5	4 Secure
Oxalis montana	Common Wood Sorrel	S5	4 Secure
Oxalis stricta	European Wood Sorrel	S5	4 Secure
Polygonum cilinode	Fringed Black Bindweed	S5	4 Secure
Trientalis borealis	Northern Starflower	S5	4 Secure
Orthilia secunda	One-sided Wintergreen	S5	4 Secure
Coptis trifolia	Goldthread	S5	4 Secure
Ranunculus abortivus	Kidney-Leaved Buttercup	S5	4 Secure
Amelanchier spp.	Serviceberry spp.	-	-
Fragaria virginiana	Wild Strawberry	S5	4 Secure
Geum aleppicum	Yellow Avens	S5	4 Secure
Prunus serotina	Black Cherry	S5	4 Secure
Mimulus ringens	Square-stemmed Monkeyflower	S5	4 Secure
Veronica officinalis	Common Speedwell	S5	7 Exotic
Veronica scutellata	Marsh Speedwell	S5	4 Secure
Viola spp.	Violet spp.	-	-
Juniperus communis	Common Juniper	S5	4 Secure
Abies balsamea	Balsam Fir	S5	4 Secure
Pinus strobus	Eastern White Pine	S5	4 Secure
Carex projecta	Necklace Sedge	S5	4 Secure
Eleocharis tenuis	Slender Spikerush	S4S5	4 Secure
Clintonia borealis	Yellow Bluebead Lily	S5	4 Secure
Maianthemum canadense	Wild Lily-of-The-Valley	S5	4 Secure
Trillium undulatum	Painted Trillium	S5	4 Secure
Dennstaedtia punctilobula	Eastern Hay-Scented Fern	S5	4 Secure
Pteridium aquilinum	Bracken Fern	S5	4 Secure
Dryopteris carthusiana	Spinulose Wood Fern	S5	4 Secure
Dryopteris intermedia	Evergreen Wood Fern	S5	4 Secure
Phegopteris connectilis	Northern Beech Fern	S5	4 Secure
Thelypteris noveboracensis	New York Fern	S5	4 Secure

Appendix D

Site Specific Maritime Breeding Bird Atlas

Region/région:12 *New Brunswick* **Salt Springs** *Nouveau-Brunswick* 20KR94



Roadside Point Count Coordinates/
Coordonnées de points d'écoute
de bordure de route

#	Easting/ Abscisse	Northing/ Ordonnée
1	293,444	5,046,798
2	296,194	5,043,999
3	296,857	5,042,308
4	296,254	5,046,502
5	298,259	5,044,487
6	290,576	5,049,101
7	292,453	5,041,903
8	299,444	5,041,044
9	296,498	5,045,454
10	291,310	5,043,301
11	297,768	5,043,614
12	299,637	5,049,241
13	298,727	5,047,784
14	296,677	5,044,226
15	292,179	5,044,199
16	293,959	5,048,786
17	295,220	5,040,734
18	293,200	5,042,698
19	293,564	5,047,660
20	297,931	5,049,431
21	297,177	5,042,701
22	298,664	5,044,779
23	294,375	5,049,059
24	290,916	5,046,609
25	295,336	5,044,396
26	293,986	5,040,373
27	291,422	5,046,585
28	297,680	5,048,989
29	295,445	5,043,812
30	292,071	5,044,682
31	291,614	5,046,120
32	291,030	5,049,311
33	293,800	5,042,894
34	299,519	5,049,740
35	296,242	5,040,235
36	291,990	5,049,726
37	298,354	5,049,692
38	297,373	5,044,699
39	290,433	5,046,435
40	295,733	5,040,273

6° Universal Transverse Mercator (UTM) Projection; Zone 20,
Central Meridian 63° West; North American Datum 1983 (NAD 83)
© Crown Copyright, Province of New Brunswick, 2006, All rights reserved

Projection universelle transverse de Mercator (UTM) 6°
Zone 20, méridien central 63° ouest;
Système de référence géodésique nord-américain 1983 (NAD 83)
© Droit d'auteur de la Couronne,
Province du Nouveau-Brunswick, 2006, Tous droits réservés.

Maritime Breeding Bird Atlas 2006 - 2010 Atlas des oiseaux nicheurs des Maritimes

Salt Springs

Region/région: 12 20KR94

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
The New Brunswick Department of Natural Resources
accepts no liability for any errors, deficiencies, or faults on this map.

This map is for use in Maritime Breeding Bird Atlas work only.

Production cartographique de la Province du Nouveau-Brunswick, Ministère
des Ressources naturelles, Direction de la pêche sportive et de la chasse, 2006
Avis
Le Ministère des Ressources naturelles du Nouveau-Brunswick
ne peut être tenu responsable pour des erreurs, défectuosités,
ou anomalies dans la présente carte.

L'usage de cette carte est limité aux activités de l'Atlas des oiseaux
nicheurs des Maritimes seulement.

Atlas des oiseaux nicheurs des Maritimes Breeding Bird Atlas

New Nouveau Brunswick
Natural Resources Ressources naturelles

Bird Studies Canada / Études d'oiseaux Canada

Table D.1. MBBA Results for Square 20KR94

Common Name	Scientific Name	Breeding Status
Canada Goose	*Branta canadensis*	Confirmed
Wood Duck	*Aix sponsa*	Possible
American Black Duck	*Anas rubripes*	Possible
Mallard	*Anas platyrhynchos*	Confirmed
Common Merganser	*Mergus merganser*	Confirmed
Ruffed Grouse	*Bonasa umbellus*	Confirmed
Great Blue Heron	*Ardea herodias*	Possible
Turkey Vulture	*Cathartes aura*	Possible
Osprey	*Pandion haliaetus*	Possible
Bald Eagle	*Haliaeetus leucocephalus*	Probable
Northern Harrier	*Circus cyaneus*	Confirmed
Sharp-shinned Hawk	*Accipiter striatus*	Probable
Broad-winged Hawk	*Buteo platypterus*	Confirmed
Red-tailed Hawk	*Buteo jamaicensis*	Confirmed
American Woodcock	*Scolopax minor*	Possible
Rock Pigeon	*Columba livia*	Confirmed
Mourning Dove	*Zenaida macroura*	Confirmed
Black-billed Cuckoo	*Coccyzus erythropthalmus*	Confirmed
Great Horned Owl	*Bubo virginianus*	Possible
Barred Owl	*Strix varia*	Probable
Common Nighthawk	*Chordeiles minor*	Probable
Ruby-throated Hummingbird	*Archilochus colubris*	Probable
Belted Kingfisher	*Ceryle alcyon*	Confirmed
Yellow-bellied Sapsucker	*Sphyrapicus varius*	Possible
Downy Woodpecker	*Picoides pubescens*	Probable
Hairy Woodpecker	*Picoides villosus*	Probable
Northern Flicker	*Colaptes auratus*	Confirmed
Pileated Woodpecker	*Dryocopus pileatus*	Confirmed
American Kestrel	*Falco sparverius*	Probable
Merlin	*Falco columbarius*	Confirmed
Eastern Wood-Pewee	*Contopus virens*	Probable
Yellow-bellied Flycatcher	*Empidonax flaviventris*	Probable
Alder Flycatcher	*Empidonax alnorum*	Confirmed
Least Flycatcher	*Empidonax minimus*	Confirmed
Eastern Phoebe	*Sayornis phoebe*	Confirmed
Eastern Kingbird	*Tyrannus tyrannus*	Confirmed

Blue-headed Vireo	*Vireo solitarius*	Confirmed
Red-eyed Vireo		Confirmed
Gray Jay	*Perisoreus canadensis*	Confirmed
Blue Jay	*Cyanocitta cristata*	Confirmed
American Crow	*Corvus brachyrhynchos*	Confirmed
Common Raven	*Corvus corax*	Confirmed
Tree Swallow	*Tachycineta bicolor*	Confirmed
Bank Swallow	*Riparia riparia*	Probable
Cliff Swallow	*Petrochelidon pyrrhonota*	Probable
Barn Swallow	*Hirundo rustica*	Confirmed
Black-capped Chickadee	*Poecile atricapilla*	Confirmed
Boreal Chickadee	*Poecile hudsonica*	Confirmed
Red-breasted Nuthatch	*Sitta canadensis*	Confirmed
Brown Creeper	*Certhia americana*	Possible
Winter Wren	*Troglodytes troglodytes*	Confirmed
Golden-crowned Kinglet	*Regulus satrapa*	Possible
Ruby-crowned Kinglet	*Regulus calendula*	Confirmed
Veery	*Catharus fuscescens*	Possible
Swainson's Thrush	*Catharus ustulatus*	Confirmed
Hermit Thrush	*Catharus guttatus*	Confirmed
American Robin	*Turdus migratorius*	Confirmed
Gray Catbird	*Dumetella carolinensis*	Confirmed
Northern Mockingbird	*Mimus polyglottos*	Confirmed
European Starling	*Sturnus vulgaris*	Confirmed
Cedar Waxwing	*Bombycilla cedrorum*	Confirmed
Ovenbird	*Seiurus aurocapillus*	Confirmed
Northern Waterthrush	*Seiurus noveboracensis*	Probable
Black-and-white Warbler	*Mniotilta varia*	Confirmed
Tennessee Warbler	*Vermivora peregrina*	Confirmed
Nashville Warbler	*Vermivora ruficapilla*	Confirmed
Mourning Warbler	*Oporornis philadelphia*	Probable
Common Yellowthroat	*Geothlypis trichas*	Confirmed
American Redstart	*Setophaga ruticilla*	Confirmed
Northern Parula	*Parula americana*	Confirmed
Magnolia Warbler	*Dendroica magnolia*	Confirmed
Bay-breasted Warbler	*Dendroica castanea*	Probable
Blackburnian Warbler	*Dendroica fusca*	Confirmed

Yellow Warbler	*Dendroica petechia*	Confirmed
Chestnut-sided Warbler	*Dendroica pensylvanica*	Confirmed
Blackpoll Warbler	*Dendroica striata*	Possible
Black-throated Blue Warbler	*Dendroica caerulescens*	Confirmed
Palm Warbler	*Dendroica palmarum*	Probable
Yellow-rumped Warbler	*Dendroica coronata*	Confirmed
Black-throated Green Warbler	*Dendroica virens*	Confirmed
Canada Warbler	*Wilsonia canadensis*	Confirmed
Wilson's Warbler	*Wilsonia pusilla*	Confirmed
Chipping Sparrow	*Spizella passerina*	Confirmed
Savannah Sparrow	*Passerculus sandwichensis*	Confirmed
Song Sparrow	*Melospiza melodia*	Confirmed
Lincoln's Sparrow	*Melospiza lincolnii*	Possible
Swamp Sparrow	*Melospiza georgiana*	Probable
White-throated Sparrow	*Zonotrichia albicollis*	Confirmed
Dark-eyed Junco	*Junco hyemalis*	Confirmed
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	Probable
Bobolink	*Dolichonyx oryzivorus*	Confirmed
Red-winged Blackbird	*Agelaius phoeniceus*	Probable
Common Grackle	*Quiscalus quiscula*	Confirmed
Purple Finch	*Carpodacus purpureus*	Confirmed
Pine Siskin	*Carduelis pinus*	Confirmed
American Goldfinch	*Carduelis tristis*	Confirmed

Appendix E

First Nation Engagement – Information Package

HRH

Hammond River Holdings

October 26, 2018

Company Name
Address Line
City, Province
Postal Code

Attention: Chief

RE: Proposed Upham East Gypsum Quarry Project, Upham, New Brunswick

INTRODUCTION

Hammond River Holdings Limited (Hammond River Holdings) is proposing to develop a gypsum quarry (the 'project') in the community of Upham, Kings County, New Brunswick (**Figure 1**, attached) and would appreciate the opportunity to meet with you or your representatives to discuss our proposed project.

Natural gypsum is a soft, white or grey colored rock that is used in products such as toothpaste, shampoo, paints, fertilizer and wallboard. Natural gypsum has been historically quarried through the development of an open pit across the Maritimes for over 150 years.

As you may be aware, Hammond River Holdings began an exploration program earlier in 2018 for the potential quarrying of gypsum as a raw material in the production of gypsum wallboard. The Aboriginal Affairs Secretariat was notified of the exploration activities prior to commencement. Through this exploration program, the Upham East property was identified as representing a potential supply of suitable quality gypsum rock that could reasonably be extracted utilizing standard quarrying techniques.

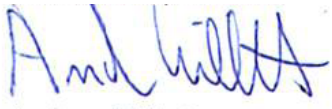
The project is proposed to be carried out on approximately 60 hectares of privately owned land near the community of Upham, New Brunswick. Although the project is still very early in the planning stages, we anticipate that the project would include an open pit for the purposes of extracting approximately 250,000 metric tonnes per year of gypsum rock with minimal processing (i.e. crushing), some material storage and transportation to an off site commercial facility.

The proposed project is an "undertaking" under item (a) 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"*]. As such, the project will soon be registered with the New Brunswick Department of Environment and Local Government under Section 5(1) of the EIA Regulation. Once registered, the EIA registration document will be available for review on the NBDELG website (https://www2.gnb.ca/content/gnb/en/departments/elg/environment/content/environmental_impactassessment/registrations.html). Should you wish to receive a copy of the EIA registration document,

please contact the undersigned and we will be happy to provide a copy to you.

Hammond River Holdings welcomes the opportunity to further discuss the proposed project, as well as the contents of our EIA registration, with you. Please contact our consultant, Dillon Consulting, at the numbers provided below to arrange a convenient time and location for further discussion.

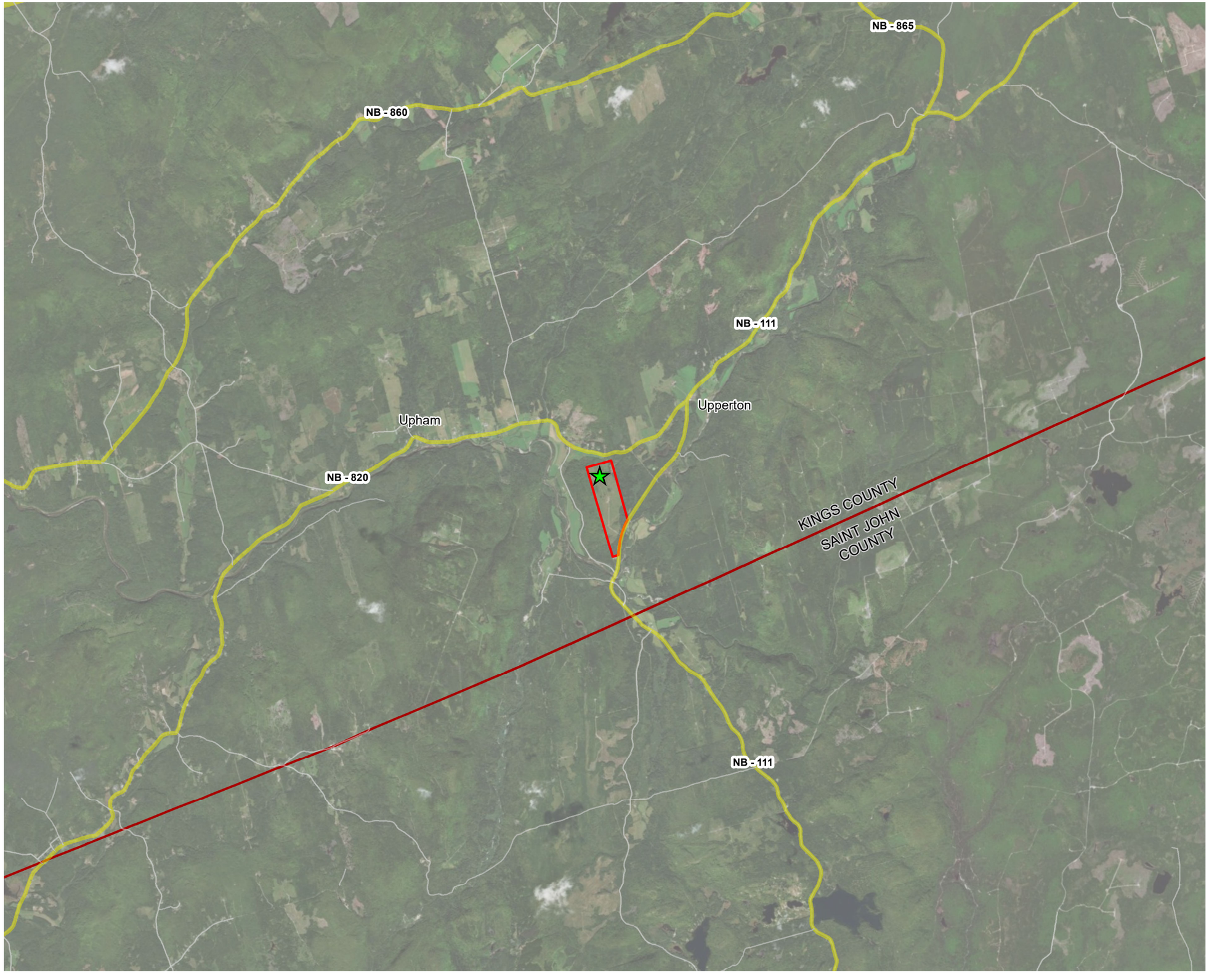
Yours sincerely,



Andrew Willett
on behalf of
Hammond River Holdings
210-65 Regent Street
Fredericton, NB E3B 7H8
info@hammondriverholdings.com



Kristin Banks, P.Eng.
Dillon Consulting
1149 Smythe Street, Suite 200
Fredericton, NB E3B 3H4
506.444.9717 x5138
KBanks@Dillon.ca



HAMMOND RIVER HOLDINGS LIMITED
PROPOSED UPHAM EAST GYPSUM QUARRY

SITE LOCATION PLAN
FIGURE 1.2.1

SITE LOCATION
PROJECT DEVELOPMENT AREA
COUNTIES



0 0.25 0.5 1 Kilometers

SCALE 1:65,000

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: BQS
MAP REVIEWED BY: CS
MAP CHECKED BY: DM
MAP PROJECTION: NAD_1983_CSRS_New_Brunswick_Stereographic

DILLON CONSULTING

PROJECT: 18-8346
STATUS: FINAL
DATE: OCT 2018

Appendix F

Public Consultation – Information Package

What does this project involve?

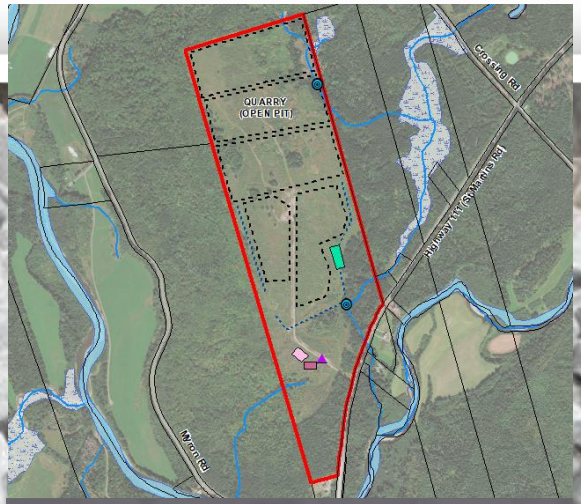
• An open pit (quarry), for extracting ~250,000 tonnes per year of gypsum rock - located along Route 111 (near Myron Road);
• The use of blasting to extract gypsum;
• Portable crushing equipment, for primary crushing of extracted gypsum rock to a diameter of ~6-8 inches;
• Mobile equipment (e.g., front end loader, excavators, dump trucks) for moving gypsum, topsoil and overburden on-site and for loading gypsum into trucks for transportation to customers;
• Water management pond.

How might the project affect me and/or my community?

If approved, operations (such as blasting) will run on a part time basis and will be limited to daytime. During operation hours, transport trucks will be used to transport gypsum to customers.
Tree buffers will be retained as much as possible around the quarry to reduce noise and impacts to viewscape.
The project is anticipated to provide jobs to local contractors.
In addition to other mitigation, the following mitigation will be implemented:

- Dust suppression;
- Minimizing the land area to be used by the project (to the extent possible);
- Avoiding wetlands/watercourses where possible (and obtaining proper authorizations and compensation plans where not possible);
- Detailed emergency response plan.

Refer to the EIA registration for a full list of mitigation measures for the project.



How can I ask questions or find out more information?

If you have questions regarding the EIA process or the proposed gypsum quarry operation, please contact Hammond River Holdings by email at:
info@hammondriverholdings.com
or by phone at: 506-632-4494

Visit the New Brunswick Department of Environment and Local Government EIA website to view an online copy of the EIA registration document under review for the project.

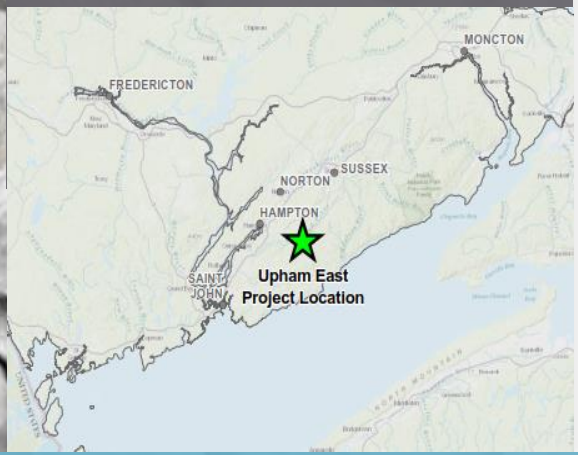
EIA Registration File Number:
XXXXXX



Proposed Gypsum Quarry

Upham East, New Brunswick

EIA Registration File Number:
XXXXXX



For more information, please contact Hammond River Holdings Limited by email at:
info@hammondriverholdings.com,
or by phone at: 506-632-4494



What is Gypsum?

Gypsum is a naturally occurring, soft and inert sulphate-based mineral.
The composition of gypsum is calcium sulphate dihydrate or $CaSO_2$ $2H_2O$.

There are two types of Gypsum:
Natural Gypsum – Quarried as a naturally occurring mineral.
Synthetic Gypsum – By-product of flue gas desulphurization in fossil fuel-fired power plants.

Gypsum is used in or for the following:
Cement; a raw material for construction; a fertilizer; an additive in paints, toothpaste and shampoo; as well as wallboard material.

Natural gypsum is mined through the development of an open pit.

Environmental Impact Assessment (EIA) Process

The New Brunswick *Environmental Impact Assessment Regulation* 87-83 under the *Clean Environment Act* establishes the EIA process in New Brunswick for certain types of developments and projects. The EIA Regulation requires that "*all commercial extraction or processing of a mineral as defined in the Mining Act*" conduct an EIA that will be reviewed by selected provincial and federal government agencies.

Through the EIA process, the proponent (i.e. the developer of the project) must complete (but are not limited to) the following:

- Engage First Nation Communities and consult with public stakeholders throughout the project;
- Provide a full and comprehensive description of the project phases (e.g. construction, operation and closure), activities (e.g. site clearing) and components (e.g. site buildings);
- Provide the anticipated project schedule and workforce needed;
- Provide the anticipated emissions and wastes that will be generated by the project;
- Explain alternative means to carrying out the project or achieving the goal of the project;
- Provide a detailed assessment of the potential environmental effects to valued components of the environment (e.g. atmospheric environment, water resources, wetlands, fish habitat, socio-economic (human) environment);
- Consider the direction, magnitude, frequency, duration, geographical extent, and reversibility of potential project-related effects;
- Evaluate potential mitigation/environmental protection measures to avoid, reduce, or control potential effects;
- Integrate project specific and general mitigation measures into the project.

Where are we now in this process?
The EIA registration document is complete, submitted to the New Brunswick Department of Environment and Local Government (NBDELG), and is under review by a committee of technical experts selected by the department.

What happens next?
The EIA registration document will be under review for an assumed 5-6 month period. An open house session will be held in the near future, for more information visit www.hammondriverholdings.com, link available after November 13, 2018.
If the project is approved by the EIA process, the proper permits received and consultation is met, construction is planned for mid-2019.
Refer to the EIA registration document that can be found on the NBDELG EIA website, for a detailed description of project activities and full list of mitigation/environmental protection measures.