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Environmental Impact Assessment Registration

Development of the North Tributary Tailings Pond (NTTP) at the Caribou Mine, New Brunswick

July 17, 2018

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This report has been prepared by a team of Stantec professionals on behalf of TMNBL.

Abbreviations

ACNOS	Atlantic Canada Nocturnal Owl Survey
AC CDC	Atlantic Canada Conservation Data Centre
AEP	Annual Exceedance Probability
AIA	Archaeological Impact Assessment
AFRP	Archaeological Field Research Permit
ARD	Acid Rock Drainage
BBS	Breeding Bird Survey
BMPs	Best Management Practices
BNCM	Blue Note Caribou Mine
BP	Before Present
CAC	Criteria Air Contaminants
CCME	Canadian Council of Ministers of the Environment
CDA	Canadian Dam Association
CEA Agency	Canadian Environmental Assessment Agency
CEAA	Canadian Environmental Assessment Act
COSEWIC	Committee on the Status od Endangered Wildlife in Canada
CRA Fisheries	Commercial, Recreational or Aboriginal Fisheries
CRHP	Canadian Register of Historic Places
DFO	Department of Fisheries and Oceans
DO	Dissolved Oxygen
EA	Environmental Assessment
ECCC	Environment and Climate Change Canada
ECMC	Ecological Communities of Management Concern
EEM	Environmental Effects Monitoring
EPT	Ephemeroptera
ESA	Environmentally Significant Areas
FDP	Final Discharge Point
GHG	Green House Gas
GNB	Government of New Brunswick
GOC	Government of Canada
GWP	Global Warming Potential

Ha	Hectares
HDPE	High Density Polyethylene
IBE	Indigenous Benefits Agreement
ICOLD	International Commission on Large Dams
IDF	Inflow Design Flood
Kw	Kilowatt
LAA	Land Assessment Area
LoM	Life of Mine
MAC	Mining Association of Canada
MAF	Mean Annual Flow
MBBA	Maritimes Breeding Bird Atlas
MBCA	Migratory Birds Convention Act
ML	Metal Leaching
MMC	Maple Minerals Corporation
MDMER	Metal and Diamond Mining Effluent Regulations
NBDELG	New Brunswick Department of Environment and Local Government
NBDERD	New Brunswick Department of Energy and Resource Development
NBDNR	New Brunswick Department of Natural Resources
NBDTHC	New Brunswick Department of Tourism, Heritage and Culture
NBRHP	New Brunswick Register of Historic Places
NB SARA	New Brunswick Species at Risk Act
NFGS	Nepisiguit Falls Generating Station
NPRI	National Pollutant Releast Inventory
NTS	National Topographical System
NTTP	North Tributary Tailings Pond
NOWL	Normal Operating Water Level
OMS	Operational, Management and Surveillance
PDA	Project Development Area
PEL	Probable Effects Level
PIEVC	Public Infrastructure Engineering Vulnerability Committee
PNA	Protected Natural Area
POLs	Petroleum, Oil and Lubricants
PPD	Polishing Pond Discharge
PM	Particulate Matter

RCMP	Royal Canadian Mounted Police
SAR	Species at Risk
SARA	Species at Risk Act
SOCC	Species of Conservation Concern
STTP	South Tributary Tailings Pond
TIA	Tailings Impoundment Areas
TMF	Tailings Management Facility
TMNBL	Trevali Mining (New Brunswick) Ltd.
TSSEMP	Trevali Site Specific Environmental Management Plan
UNFCCC	United Nations Framework Convention on Climate Change
US EPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
VCs	Valued Components
WAWA	Watercourse and Wetland Alteration
WNS	White Nose Syndrome
WSC	Water Survey of Canada
WTP	Water Treatment Plant

1.0 INTRODUCTION

This document is intended to fulfill the requirements for registration of an Undertaking under New Brunswick's *Environmental Impact Assessment Regulation* of the *Clean Environment Act* for the proposed construction and operation of a new tailings management facility (TMF) referred to as the North Tributary Tailings Pond (NTTP; the Project), at the Caribou mine in northern New Brunswick. The Project is proposed by Trevali Mining (New Brunswick) Ltd. (TMNBL; the Proponent) and consists of constructing a new tailings management facility, a polishing pond, a water treatment facility, and supporting permanent and non-permanent ancillary facilities to support the ongoing mining and milling operations at the Caribou mine.

1.1 BACKGROUND

The mine and mill, located approximately 45 km southwest of Bathurst, New Brunswick, is an underground lead-zinc-silver mine and milling complex that processes up to 3,000 tonnes per day of ore (Figure 1.1).

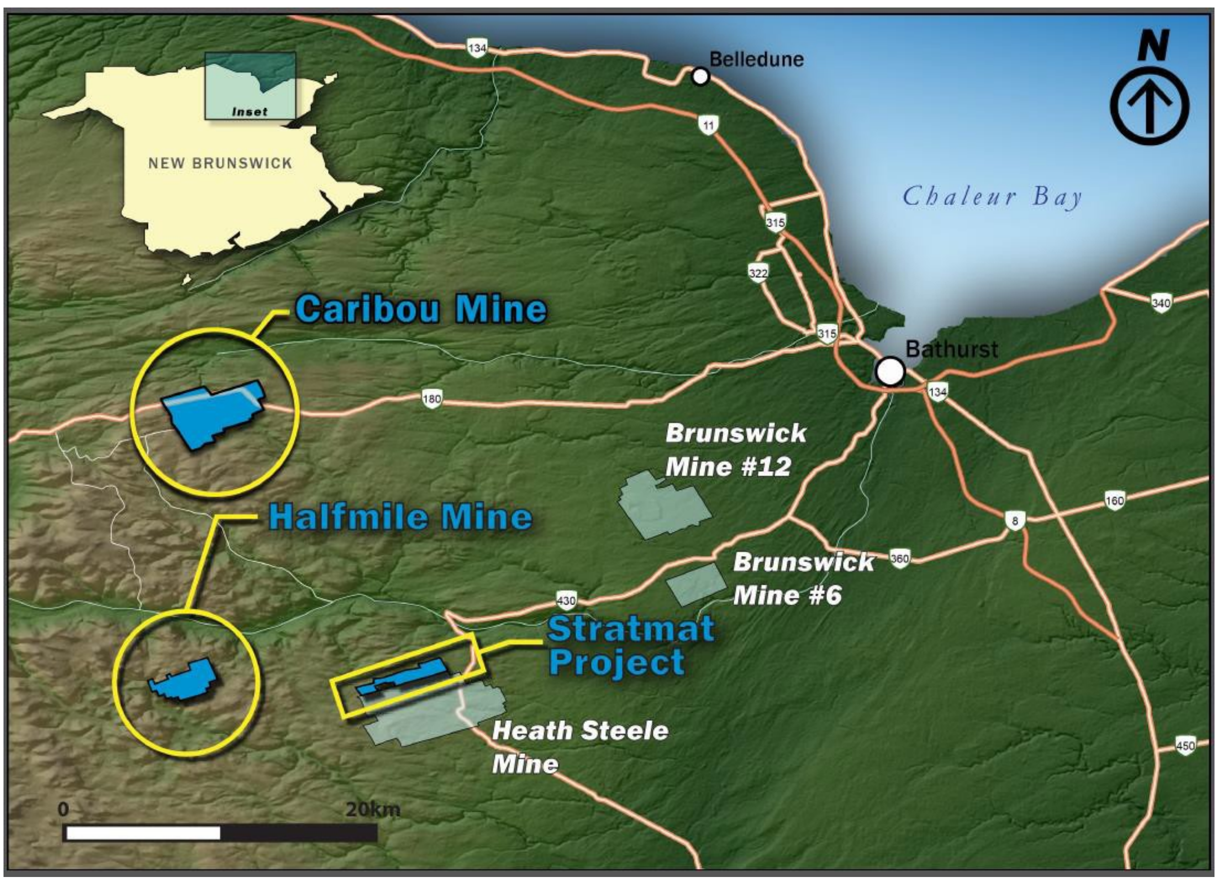

Figure 1.1 Caribou Mine Location

For more than 50 years, the Caribou mine has been explored and mined, and has produced various concentrates such as lead, zinc, copper, silver, and gold. Between 1969 and 1974, Anaconda Mining Inc. developed and mined the West and East open pits at the mine site. Between 1974 and 1983, a small gold heap leach process was operated.

Various mining companies owned and operated the Caribou mine in the 1980s and 1990s; however, due to poor recoveries and low metal prices, the Caribou mine was put into “care and maintenance” in 1998. Blue Note Caribou Mine Inc. (BNCM), a subsidiary of Blue Note Metals Inc., purchased the Caribou mine in 2006 and began mining and milling operations in August 2007. While significant progress was made in terms of mineral recoveries, a global crash in commodity prices coupled with high production costs, forced BNCM to cease all operations in October 2008. After BNCM filed for bankruptcy protection in February 2009, the Province of New Brunswick was ordered by the New Brunswick Court of Queen’s Bench to ensure environmental and public safety at the Caribou mine site. BNCM subsequently declared bankruptcy in July 2009.

In the summer of 2009, the physical assets of the Caribou mine site were acquired by Maple Minerals Corporation (MMC); MMC was subsequently sold to and amalgamated with TMNBL in November 2012. Between 2013 and 2015, TMNBL proceeded to rehabilitate the underground mine and milling complex. In March 2015, the mine started ramping up operations and achieved commercial operation in July 2016.

The current (approved) Caribou complex consists of an underground mining complex and related subsurface equipment, a primary crusher and related conveying systems, a mill and processing operation to produce concentrates to be shipped to external smelting and processing facilities, a TMF (known as the South Tributary Tailings Pond, or STTP), and related mining and milling processes and operations. The mill has a maximum ore processing rate of 3,000 tonnes per day.

Current ore resources at a milling rate of 3,000 tonnes per day will see the Caribou mine operating for approximately another 5 to 6 years.

1.2 PROJECT OVERVIEW

The purposes of the Project are to provide additional TMF storage capacity to supplement Caribou’s current TMF storage and to mitigate some of the historical acid rock drainage (ARD) from historical pre-Trevali sources located on-site. The construction of the dam as part of a new TMF will provide additional tailings storage capacity to accommodate current and future tailings storage requirements for the Caribou mine and its potential satellite deposits. In addition, the construction of this dam will enhance reclamation of the entire mine site, including the legacy of the Anaconda tailings area and the surface waste rock ARD stockpiles.

Based on most recent bathymetry soundings carried out on behalf of TMNBL, the STTP has an estimated remaining storage capacity equivalent to approximately two years at current production rates. Since the Caribou mine has a remaining life of approximately 5 to 6 years based on current production rates, and in light of TMNBL’s plans to develop other mineral deposits that will require processing at Caribou, additional tailings storage capacity is required.

Over the years, TMNBL has explored various options to site a new TMF, and the most technically and economically feasible option for tailings storage has been identified as a new TMF constructed over a portion of Forty Mile Brook, referred to as the NTTP. The Project thus involves the construction of a new TMF dam, TMF basin, polishing pond and dam, and water treatment facilities. The NTTP and associated components, constructed in two stages, will be located north and northeast of the Caribou mine site constructed over a portion of Forty Mile Brook, below the confluence of the north and south tributaries to Forty Mile Brook, downgradient of the Caribou mine site. Once operational, in addition to receiving tailings from the current operation of the Caribou mill, the NTTP will also receive and contain effluent from historical ARD from historical pre-Trevali sources located on-site, including the former Anaconda tailings. In this manner, water quality within Forty Mile Brook downstream of the new TMF and dam will be expected to improve over time as legacy ARD issues will be contained by the new TMF. As with the STTP, the tailings will need to be submerged in the NTTP to prevent the generation of ARD and associated metal leaching (ML).

The Stage 1 components include a tailings dam, TMF basin, a polishing pond and dam, and water treatment plant. Stage 2 will eventually see the construction of a larger tailings dam and expanded NTTP basin as part of mine closure, and also require the construction of an alternative access road to the Caribou site.

1.3 PROPONENT INFORMATION

The Project may be cited as the “Development of the North Tributary Tailings Pond at the Caribou mine, New Brunswick”.

The proponent for the proposed undertaking is as follows:

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President & Chief Executive Officer:	Dr. Mark Cruise
Mailing Address of Corporate Office:	1400 – 1199 West Hastings Street Vancouver, British Columbia V6E 2K3 Tel: (604) 488-1661; Fax: (604) 408-7499
Contact Person for this EIA Registration:	Mr. Gordon Sheppard, P.Eng. Environmental Lead Trevali Mining (New Brunswick) Ltd. 9361 Highway 180, P.O. Box 790, Station Main Bathurst, NB E2A 4A5 Tel.: (506) 545-6097 ext. 2192; Fax: (506) 545-6402 Email: gsheppard@trevali.com
Proponent Website:	www.trevali.com

1.4 PURPOSE/RATIONALE/NEED FOR THE PROJECT

The current life of mine (LoM) for the Caribou mine (approximately 5 to 6 years at current mining rates) exceeds the current storage capacity of the STTP. The construction of a new TMF is therefore required to provide additional capacity for the subaqueous storage of tailings arising from the processing of ore into concentrates, thereby allowing the mine and mill to continue to operate to the current end of LoM. The proposed NTTP will consist of the construction of a dam (Stage 1) below the confluence of the north and south tributaries to Forty Mile Brook, which in addition to allowing for the continued subaqueous storage of tailings, will also serve to capture surface and groundwater impacted flows which will be stored and treated in the newly created TMF. Stage 1 will continue until the end of LoM.

The second objective of the NTTP (Stage 2) is to permanently inundate the remaining historical legacy of the Anaconda tailings area and the surface waste rock ARD stockpiles, the G-Pond, and the underground mine workings to enhance reclamation of the entire mine site at the end of LoM. Should the mill continue to operate as a toll-milling facility following the LoM by processing ore from various satellite deposits in northern New Brunswick, Stage 2 of the TMF will provide additional tailings storage capacity for such operation. In addition to providing a more realistic "walk-away" closure plan, the flooding of the site at Stage 2 will lead to the rehabilitation of the Forty Mile Brook watershed (over time), up to the confluence of the Nepisiguit River, as the current water quality in Forty Mile Brook is adversely affected by ARD runoff. Following the construction of the new TMF, water quality in Forty Mile Brook downstream of the NTTP is expected to gradually improve due to water treatment and/or by subaqueous storage of ARD waste rock and tailings.

1.4.1 Alternatives to the Project

The disposal of tailings is a necessary part of the operation of a mine and mill. Without the creation of additional capacity for tailings storage, at current mining rates, the STTP is expected to reach capacity around the year 2020-2021.

The alternative to expanding tailings management capacity at the mine is to close the mine once the STTP has reached its capacity. This alternative will result in the premature end of mining and associated revenue being generated, which is required to partially fund eventual mine closure. Ending operations prematurely at the mine will also result in the loss of approximately 300 jobs at the mine, and will require an alternative solution for closing the mine (which currently includes the creation of the Stage 2 TMF). As such, this alternative to the Project is not considered economically or operationally feasible.

No other alternatives to the Project were identified as being technically or economically feasible to meet the Project purpose.

1.5 PROPERTY OWNERSHIP

The Caribou mine property (PID No. 50072032) is solely owned by TMNBL and covers an area of 509.5 hectares (ha). The centre of the Caribou mine property is located at coordinates N 7618472 and E 2515620 (NB Double Stereographic). This property is located within the larger mining lease, ML-246, covering 3,105.7 hectares (ha). The lease is held solely by TMNBL and has a 20-year term that is set to expire on October 27, 2028. Portions of the lease outside of PID No. 50072032 are owned by the Province of New Brunswick.

The Caribou mine also includes a second property (PID No. 50237924) which is an industrial surface lease, SIML2271, covering approximately 90 ha, and includes the existing STTP. The lease has a 20-year term and is set to expire on May 31, 2026. This property is owned by the Province of New Brunswick and is held solely by TMNBL. Property boundaries for the mine are shown on Figure 1.2.

Portions of the Project will extend outside of the TMNBL owned property onto adjacent Crown land (PID Nos. 50184019 and 50071885).

1.6 REGULATORY CONTEXT

1.6.1 Provincial Environmental Regulatory Requirements

1.6.1.1 Environmental Impact Assessment Regulation – Clean Environment Act

The Project is subject to the New Brunswick *Environmental Impact Assessment Regulation – Clean Environment Act* (referred to as the EIA Regulation). The EIA Regulation requires that the proposed construction, operation, modification, extension, abandonment, demolition or rehabilitation of certain projects or activities, called “undertakings” and described in Schedule A of the Regulation, must be registered. Schedule A includes 24 categories of projects or activities, one of which is “(a) all commercial extraction or processing of a mineral as defined in the *Mining Act*”. Therefore, the proposed construction and operation of the NTTP requires registration under the EIA Regulation, at minimum.

1.6.1.2 Approval to Construct/Operate

Pursuant to paragraph 8(1) of the *Water Quality Regulation* under the *Clean Environment Act*, the construction and operation of the TMF will require an Approval to Construct/Operate to be obtained and/or the current Approval to be amended to include the proposed new TMF. Currently, the Caribou mine site is operating under Approval to Operate I-10186 issued on July 1, 2018 to TMNBL (NBDELG 2018a). Approval to Operate I-10186, which is valid until May 31, 2021, allows for the operation of the underground mine, milling complex, TMF and the associated surface infrastructure, and defines terms and conditions (such as discharge limits, testing and monitoring requirements, and reporting requirements) that the facility must comply with as part of its operation in order to remain in compliance with the regulations.

1.6.1.3 Watercourse and Wetland Alteration Permit

The *Watercourse and Wetland Alteration Regulation* under the *Clean Water Act,* states that any person working within 30 metres of a watercourse or wetland must obtain a Watercourse and Wetland Alteration (WAWA) permit prior to doing so. Since the construction of the dam and TMF will be completed on Forty Mile Brook and a portion of the watercourse and some riparian wetlands will be flooded and/or altered, a WAWA permit (with associated compensation for any net loss of wetland function) will be required.

1.6.1.4 Licence of Occupation or Lease

As the NTTP dam and polishing pond will extend slightly beyond the current property boundaries for the Caribou mine, pursuant to the *Crown Lands and Forest Act*, an idustrial lease for the Project’s footprint outside the TMNBL property will be required. A lease is a legal agreement authorizing the exclusive access rights to Crown lands for a specific period of time under specific terms and conditions as the Minister of Energy and Resource Development determines to be appropriate. Although the exact location is not determined, it is anticipated that the alternate access road will require a licence of occupation, which differs in that it authorizes non-exclusive occupation of crown lands.

Both a lease and licence, and any subsequent renewal, cannot exceed twenty years, as per sections 24 and 26 of the *Crown Lands and Forest Act*, respectively.

1.6.1.5 Quarry Permit and/or Quarry Lease

Construction of the NTTP and dam will require a substantial amount of aggregate. It is anticipated that nearby local aggregate sources will be used in order to complete construction, though it is also possible (though likely cost prohibitive) to transport aggregate to the site from local approved pits or quarries. Pursuant to the *Quarriable Substances Act* and its *regulations*, a quarry permit and/or quarry lease will be required to develop a quarry on Crown land.

1.6.1.6 Other Potential Provincial Permit Requirements

Table 1.1 identifies other provincial permits, approvals, and authorizations that may or may not be applicable to the Project. Note this is not an all-inclusive list.

Table 1.1 Other Potential Provincial Permit Requirements

Permit, Approval or Authorization	Scope, and Issuing Agency
Archaeological Field Research Permit	Required to carry out an archaeological impact assessment (AIA) of the Project footprint. Issued by the Archaeological Services Branch, New Brunswick Department of Tourism, Heritage and Culture
New Brunswick *Species at Risk Act* Permit	Required if alteration or loss of species at risk or their habitat is needed as a result of the Project. Issued by the New Brunswick Department of Energy and Resource Development (NBDERD)
New Brunswick *Forest Fires Act* Work Permit	Under Section 15(1) of the *Forest Fires Act*, a work permit will be required to conduct an industrial operation on forest land. The permit expires on the last day of the fire season for which it was issued. A work permit can be obtained by applying to a New Brunswick Energy and Resource Development (NBDERD) District Ranger Office and is typically approved on the spot, subject to a suitable forest fire index.

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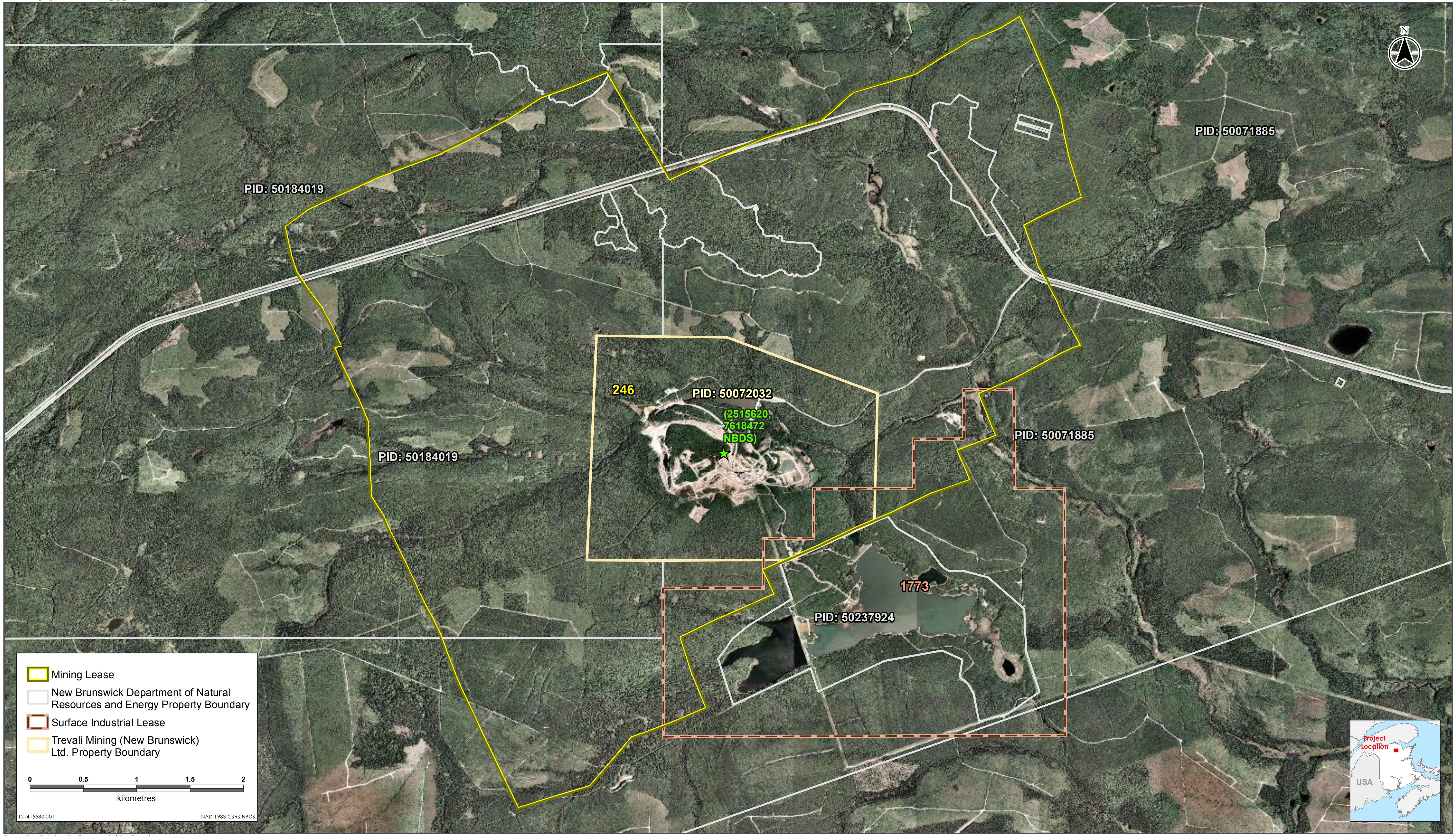

Sources: Base Data from the Government of New Brunswick
Service Layer Credits: Service New Brunswick/Service Nouveau Brunswick

Project Location and Property Boundaries

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Figure 1.2

1.6.2 Federal Environmental Regulatory Requirements

1.6.2.1 Canadian Environmental Assessment Act, 2012

The requirement for a federal environmental assessment (EA) is defined by the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) and the associated *Regulations Designating Physical Activities*. Under CEAA 2012, a "designated project" (i.e., a project or activity listed under the *Regulations Designating Physical Activities*), as well as projects carried out on federal land, require an EA under CEAA 2012.

The *Regulations Designating Physical Activities* identify a metal mine with an ore production capacity of 3,000 tonnes per day or more, or a metal mill with an ore input capacity of 4,000 tonnes per day or more, as designated projects that require a federal EA. This applies to both new facilities meeting these thresholds, as well as to expansions of existing facilities that will increase the ore production capacity by more than 50% and beyond the above-noted extraction or processing capacities.

Though a TMF is a vital part of a mine and mill, the development of a new TMF as is proposed at Caribou should not in itself be interpreted to trigger the need for a federal EA because the Project as it is currently defined is neither a new mine or mill, nor an expansion to the mine or mill that increases its ore production capacity. Rather, it is a tailings management project that is intended to provide storage capacity at an existing mine and mill, without any corresponding change in the mine's extraction rate or the mill's ore processing capacity.

The *Regulations Designating Physical Activities* identify a new dam "*that would result in the creation of a reservoir with a surface area that would exceed the annual mean surface area of a natural water body by 1,500 ha or more*" as requiring a federal EA. The total surface area of the reservoir to be formed by the NTTP will be approximately 10% of this threshold.

Therefore, the Project as currently defined is not a designated activity under CEAA 2012, and since no aspect of the Project will be carried out on federal land, a federal EA is not anticipated to be required for the Project as currently conceived.

1.6.2.2 *Fisheries Act* Authorization

The *Fisheries Act,* as amended in 2012, applies to the Project. The *Fisheries Act* is administered by Fisheries and Oceans Canada (DFO) and is the main legislation protecting fish and fisheries in Canada.

Section 35 of the *Fisheries Act* prohibits the carrying out of a work, undertaking or activity that results in "serious harm to fish that are part of a commercial, recreational or Aboriginal fishery" (hereinafter referred to as "CRA fisheries") without first obtaining an Authorization from DFO under Section 35(2) of the Act. "Serious harm to fish" is defined in the *Fisheries Act* as "*the death of fish or any permanent alteration to, or destruction of, fish habitat*". Since the Project will cover a portion of Forty Mile Brook, and that the upstream reaches of the headwaters of Forty Mile Brook are not currently proposed for diversion and will thus no longer be connected to the downstream portion of the brook but rather will drain into the new TMF, it is likely that DFO will declare that the TMF causes serious harm to fish, thus requiring authorization under Section 35 of the *Fisheries Act*. Counter-balancing this loss will be the anticipated improvement, over time, to water quality in Forty Mile Brook downstream of the mine that is currently impaired by the effects of the historical tailings and other historical sources of metal leaching.

Authorization under Section 35(2) of the Act requires that the proponent must complete an application and offset any serious harm to fish that were part of, or supported, CRA fisheries such that the productivity of the fisheries is maintained or improved. An Offsetting Plan must accompany the application for authorization, and is evaluated by DFO following the “Fisheries Productivity Investment Policy: A Proponent’s Guide to Offsetting” (DFO 2013b). The Offsetting Plan must detail how serious harm caused by the Project will be offset (or compensated) by other activities aimed at minimizing residual environmental effects of the Project on CRA fisheries. The Offsetting Plan prepared for this purpose is also required as part of the regulatory amendment to Schedule 2 of the *Metal and Diamond Mining Effluent Regulations* (discussed in the next section) and serves to fulfill both requirements. Subject to DFO approval, carrying out the Project may partially offset the environmental effects in Forty Mile Brook as part of the Section 35 authorization process.

1.6.2.3 Amendment to Schedule 2 of the Metal and Diamond Mining Effluent Regulations

Under Section 36 of the *Fisheries Act*, “*no person shall deposit or permit the deposit of a deleterious substance of any type in water frequented by fish*” without authorization.

For mines, the requirements of Section 36 of the *Fisheries Act* are further defined and regulated by the *Metal and Diamond Mining Effluent Regulations* (MDMER). The MDMER, enacted in 2002, were developed under the *Fisheries Act* to regulate the deposit of mine effluent, waste rock, tailings, low-grade ore and overburden into natural waters frequented by fish. These regulations, administered by Environment and Climate Change Canada (ECCC), apply to both new and existing metal mines. Schedule 2 of the MDMER lists water bodies designated as tailings impoundment areas (TIAs). The depositing of deleterious substances produced by mines (*e.g.*, tailings, waste rock) is addressed by the requirement for any new tailings impoundment in waters frequented by fish to be added to Schedule 2 of the MDMER by regulatory amendment.

As a prerequisite for obtaining a Schedule 2 MDMER amendment, an alternatives assessment must be conducted in accordance with the “Guidelines for the Assessment of Alternatives for Mine Waste Disposal” issued by ECCC (2016). The specific requirements will require confirmation with regulatory agencies.

1.6.2.4 Environmental Effects Monitoring

Also pursuant to the MDMER, all mines and recognized closed mines are required to conduct acute lethality testing of final effluent, effluent characterization, and Environmental Effects Monitoring (EEM) in the downstream receiving environment in three-year cycles. While Caribou is currently subjected to these MDMER requirements, the construction of the NTTP will require the registration of a new final discharge point (FDP). As an existing mine, this new FDP will continue to be subjected to the MDMER Schedule 4 effluent quality criteria.

1.6.2.5 Fishery (General) Regulations

Pursuant to Section 52 of the *Fishery (General) Regulations* under the *Fisheries Act,* a scientific collection permit will be required as part of the aquatic field studies related to the provincial EIA review and fisheries offsetting plan.

1.6.2.6 Migratory Birds Convention Act

The *Migratory Birds Convention Act* (MBCA), by way of the *Migratory Birds Regulations* and *Migratory Birds Sanctuary Regulations*, defines the provisions by which an estimated 450 native species of migratory birds (including their nests and eggs) are protected in Canada. Under the MBCA, the killing, harming, harassing, or injuring of migratory birds and their nests is prohibited.

To comply with the provisions of the MBCA, construction activities that require the removal of trees and ground vegetation are normally conducted outside of migratory bird breeding season (typically April 15 to August 30 of each year).

1.7 ORGANIZATION OF THIS DOCUMENT

This document is organized into nine chapters, as follows.

- Chapter 1 provides introductory information regarding the Project, including Project scope, information on the proponent, the purpose of the Project, the regulatory framework that is anticipated to apply to the Project, property ownership and siting considerations, and an outline of the remainder of the document.
- Chapter 2 provides a detailed description of the Project as it is currently conceived. This description includes information on: the Project location; Project components and infrastructure; how construction, operation, and closure of the Project will be achieved; mitigation by design of the Project; the anticipated Project workforce and schedule; information on emissions and wastes from the Project; a discussion of accidents, malfunctions, and unplanned events that might occur; and a discussion of environmental planning and management strategies for the Project.
- Chapter 3 provides an overview of alternative means of completing the Project that were considered.
- Chapter 4 provides an overview of the environmental setting of the Project.
- Chapter 5 provides an assessment of the potential interactions between the Project and the environment, including a description of the methods used to assess potential interactions between the Project and valued components (VCs), and details of the potential interactions between the Project and VCs. Each VC includes a description of existing conditions, discussion of potential Project-environment interactions, and mitigation for those interactions.
- Chapter 6 provides a summary of mitigation for the Project, both by design and in response to potential environmental interactions.
- Chapter 7 outlines Indigenous engagement activities planned for the Project.
- Chapter 8 outlines public involvement activities planned for the Project.
- Chapter 9 lists the references cited in this work.

2.0 PROJECT DESCRIPTION

A description of the Project as it is currently conceived is provided in this section, based on preliminary planning and design information available at the time of writing this EIA Registration. Further detailed engineering design will be completed as the Project progresses, and therefore this information is subject to change as other aspects of planning proceed. However, the approach to discussing environmental interactions in this EIA registration has been to adopt a high level of conservatism into the assessment such that any minor changes in Project design that might occur will be encompassed within the range of environmental interactions identified and discussed herein.

This section describes the existing mine and mill, the Project components, stages and activities; the anticipated Project workforce and schedule; Project-related emissions and wastes; accidents, malfunctions and unplanned events that might occur; as well as environmental protection and management strategies.

2.1 ABOUT THE EXISTING CARIBOU MINE

The Caribou mine site is comprised of two former open pit lead-zinc-silver mines, namely the west and east pits, and an underground zinc-lead-silver mine. A milling complex used to concentrate the ore is also located at the Caribou site. The Caribou site also has an existing TMF called the South Tributary Tailings Pond (STTP), where subaqueous disposal of tailings from the concentrator occurs via slurry pipeline. A historical tailings storage area called the “Anaconda Tailings” is also found on the mine site. This area consists of several unlined ponds (i.e., A, B, C, D, E, and F) which hold water and/or tailings. In addition, G Pond, located upstream of the Fire Pond, receives runoff and ARD from the West Open pit waste rock storage area. Other infrastructure on the site includes:

- Primary crusher and conveyor;
- Main concentrator building containing unit operations for milling, floatation, and concentrate production;
- Large staff/administration office and mine dry facility;
- Core shack;
- Assay laboratory;
- Warehouse;
- Maintenance shop;
- Cold storage facility;
- Compressor room;
- Electrical substation;
- Reclaim pumphouse;
- Hoist room (not currently in use);
- Head frame (not currently in use);
- Mine water treatment plant and associated treatment ponds;
- Crusher ore pad;
- Restigouche raise ore/waste rock storage pad; and
- West open pit ore/waste rock storage pad.

The underground mine is accessed via two portals: the zero-level portal and the main portal. Ramps are used to access the mine and convey the ore to surface via mine haul trucks; the shaft and skip are not used to transport personnel or materials. All waste rock from the underground mine is used as backfill underground. The site is also characterized by a fire water retention pond called the “Fire Pond” which supplements the mill with process water. Figure 2.1 provides an overview of the mine site layout and existing components of the site.

2.2 PROJECT LOCATION

The Caribou property is located in Restigouche County, approximately 45 km west of the city of Bathurst in the province of New Brunswick (Figure 1.1). The property lies within National Topographical System (NTS) map sheet 21O/09. The Caribou deposit is located on an existing mine site with extensive existing infrastructure. The TMNBL owned property is approximately 2.5 km long in the east-west direction, and 2 km wide in the north-south direction.

The proposed TMF will be located north and east of the Caribou mine site, largely within its current property, with a small portion extending outside of PID 50072032 onto adjacent Crown land. More specifically, the main TMF dam will be located at coordinates N 7618547 and E 2516875 (NB Double Stereographic).

The Project Development Area (PDA) is defined as the area of physical disturbance associated with the Project. For the purposes of this EIA registration, the PDA is divided into the footprint of components planned for Stage 1 and those planned for Stage 2, as shown in Figure 2.2. The Stage 1 PDA includes a TMF dam (including an emergency spillway), TMF basin, a polishing pond and dam, and water treatment facilities. The Stage 2 PDA includes an expanded TMF dam (with expanded emergency spillway), TMF basin, and an alternative access road to the Caribou site. The PDA also includes the locations of ancillary and temporary facilities required to support the Project (e.g., temporary laydown areas, access roads). The locations of the temporary facilities will be situated within the footprints of the TMF basin, or within areas previously disturbed as part of current mine operations. The Stage 1 PDA encompasses an area of approximately 43 ha, and the Stage 2 PDA encompasses the Stage 1 PDA plus an additional area of approximately 115 ha (for a total of 158 ha).

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MINE SITE GENERAL LAYOUT

ENVIRONMENTAL IMPACT ASSESSMENT
CARIBOU MINE, NEW BRUNSWICK

Client: TREVALI MINING (NEW BRUNSWICK) LTD.

Job No.:	121415530.300
Scale:	1 : 20,000
Date:	12-JUL-2018
Dwn. By:	JL
App'd By:	MK

Fig. No.: 2.1

Stantec

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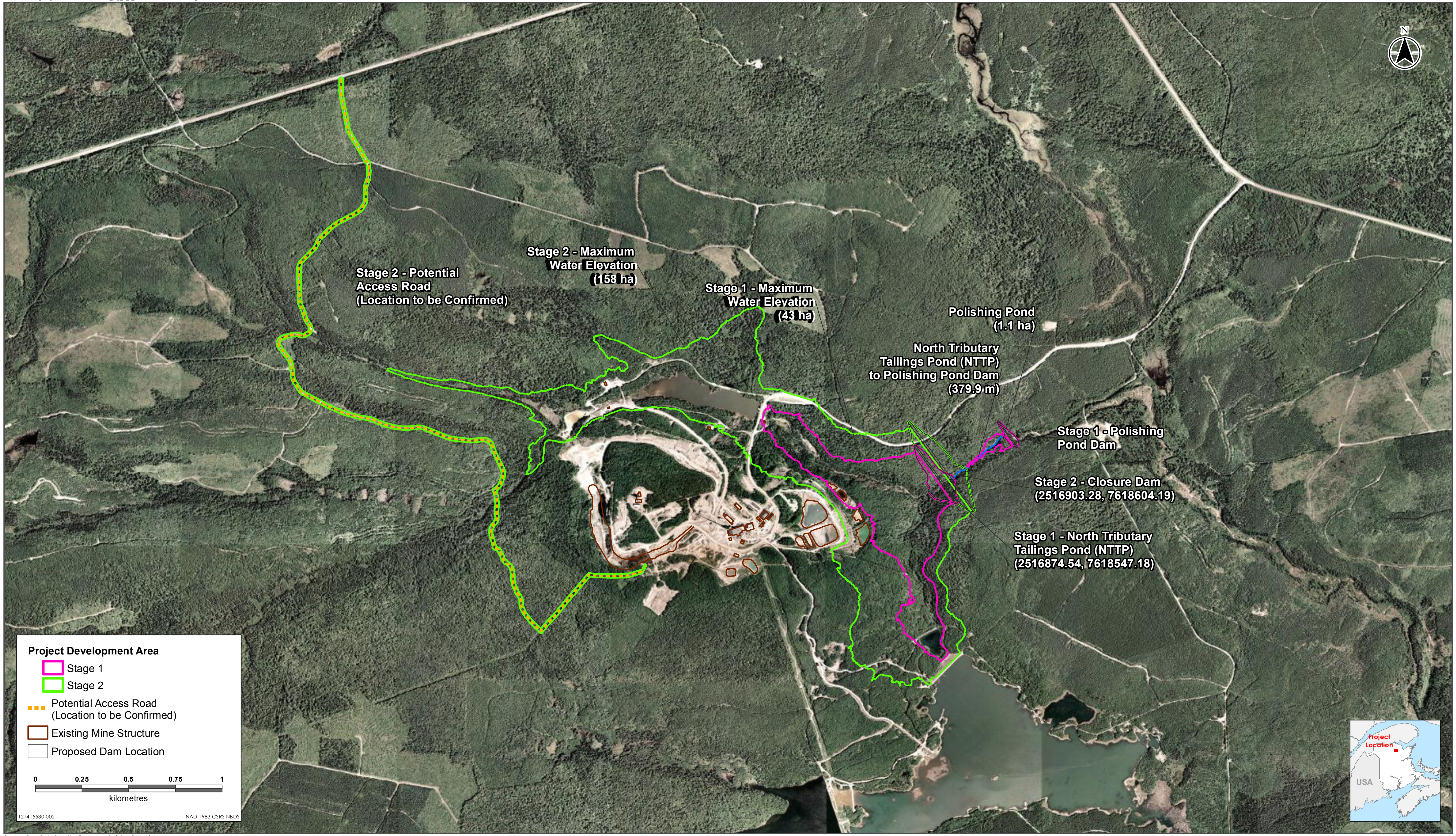

Sources: Base Data from the Government of New Brunswick
Service Layer Credits: Service New Brunswick/Service Nouveau Brunswick

Project Development Area

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121415530 - TREVALI MINING (NEW BRUNSWICK) LTD.

Figure 2.2

2.2.1 Siting Considerations

The proposed TMF dam location lies within a natural valley formation where the proposed TMF dam will be constructed downstream of the confluence of the north and south tributaries to Forty Mile Brook. This valley naturally extends north of the STTP and east of the Fire Pond. Based on the STTP tailings storage volume estimate and LoM resource estimates, the current TMF does not provide sufficient tailings storage capacity for the remaining LoM.

The Stage 1 NTTP will serve primarily to satisfy the LoM tailings storage requirements for the remainder of the life of the Caribou underground ore deposit. Under Stage 1, the TMF basin will be flooded to a normal operating elevation of 381 metres above mean sea level (m amsl), flooding much of the valleys of the north and south tributaries to the Forty Mile Brook. In addition to providing tailings storage capacity, the Stage 1 NTTP will be the first step towards the rehabilitation of the Forty Mile Brook watershed system up to the confluence of the Nepisiguit River. Construction of the new TMF dam will enhance the eventual reclamation of the entire mine site including the historical Anaconda tailings area and the surface ARD waste rock stockpiles.

The Stage 2 NTTP will continue to serve to enhance reclamation of the Caribou mine site and the continued rehabilitation of the Forty Mile Brook watershed system by providing a potential “walk away closure” plan. Under Stage 2, the TMF basin will be flooded to a normal operating water level of 398 m amsl, flooding much of the Anaconda tailings area, the existing polishing pond, the lower section of the existing diversion channel, the Fire Pond, G-Pond, and the main portal access. As the underground workings will also be flooded under this scenario, this will essentially signal the end of underground mining at Caribou mine. The polishing pond dam constructed under Stage 1 will remain during Stage 2 and will continue to capture seepage and allow for effluent treatment/settling. Under this closure scenario, long-term water quality improvements will be anticipated within Forty Mile Brook downstream of the NTTP.

Therefore, the proposed location of the TMF is (predominantly) within the existing property rights held by TMNBL, and overlaying a portion of Forty Mile Brook that has been affected by historical activity, meets the required additional tailings storage needs, and provides an opportunity to allow water quality in some of the downstream reaches of Forty Mile Brook to improve, over time.

The proposed location of the new alternative access road alignment for Stage 2 will provide access to the mine site when the Stage 2 TMF is in place. This alignment was selected as it follows existing resource roads to the extent practicable so as to reduce the footprint of new ground disturbance. This alignment is also preferred as it provides access to Route 180, and maintains a reasonable travel time to other TMNBL-owned operations in the area.

The location of the alternative access road is conceptual at this time and subject to change following engineering design and site surveys.

A discussion of alternative means of carrying out the Project, including some alternative locations for tailings management facilities, is provided in Chapter 3.0.

2.3 DESCRIPTION OF PROJECT COMPONENTS

The Project consists of constructing a new TMF to subaqueously store additional tailings to accommodate the final years of the Caribou LoM as well as to enhance the permanent closure of the mine site. The proposed Project components include:

- Stage 1:
  - Stage 1 NTTP dam, emergency spillway, and TMF basin
  - Polishing pond and dam
  - Water treatment facility
  - Permanent and temporary ancillary facilities
- Stage 2:
  - Stage 2 NTTP dam raise, expanded emergency spillway, and TMF basin
  - Alternative access road

The exact location and extent of some of the Project components are not finalized and are subject to change, although each will remain within the defined PDA.

2.3.1 Stage 1

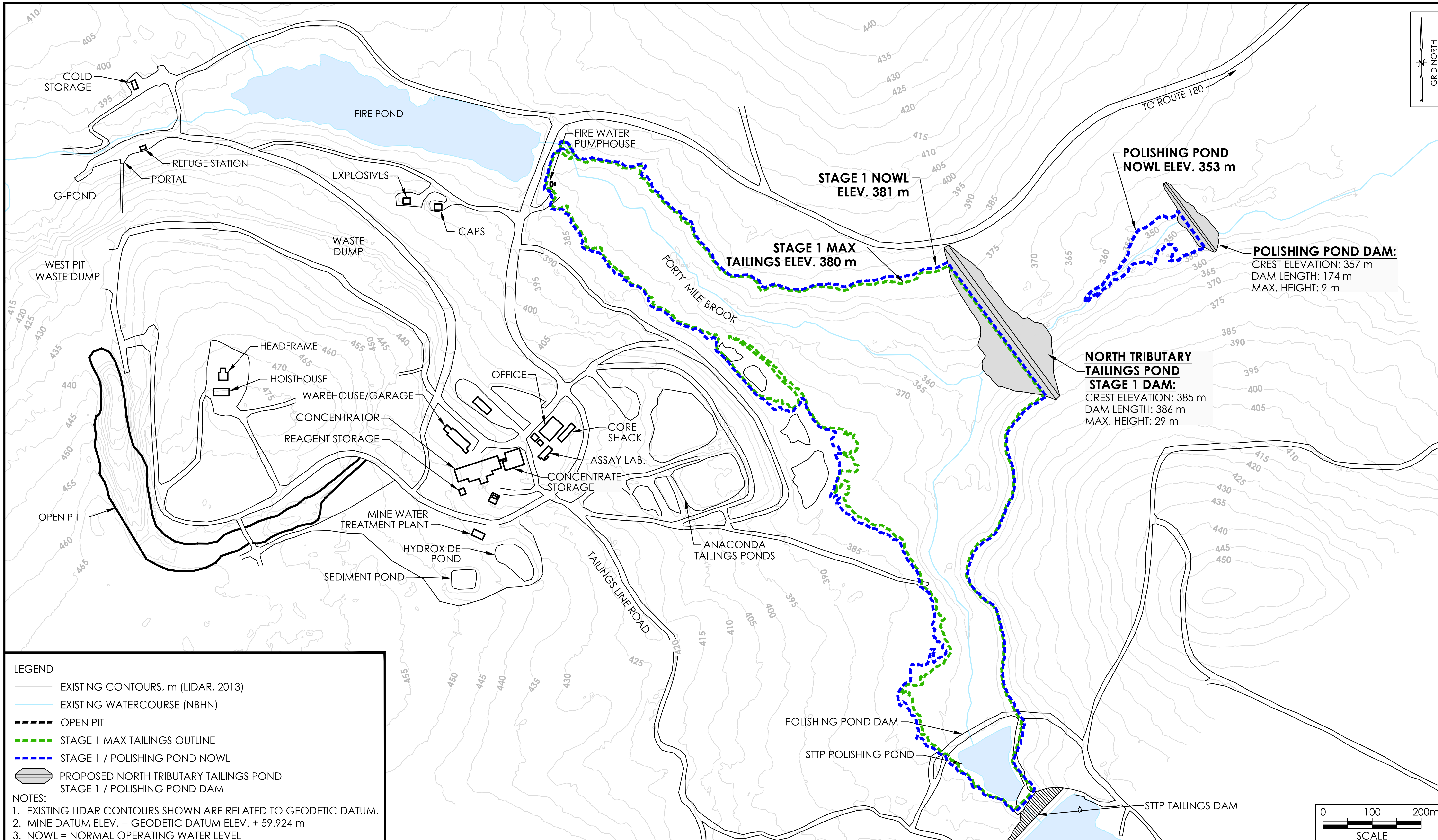
2.3.1.1 Stage 1 TMF Dam, Emergency Spillway and TMF Basin

Under Stage 1, a new approximately 30 m high TMF dam (above surrounding ground level) will be constructed below the confluence of the north and south tributaries to Forty Mile Brook. The area above the new TMF dam will be flooded to a normal operating water level of 381 m amsl, creating a new TMF basin of approximately 39 ha in size and providing 2.8 million cubic metres (Mm^3) of subaqueous tailings storage. An emergency spillway will be constructed adjacent to the TMF dam in order to route water from extreme weather events around the main dam structure.

Two options are being considered for the Stage 1 NTTP dam design at this time: an earthen rockfill dam, or a geomembrane faced rockfill dam. Both of these options will allow for downstream raises of the dam without building onto the tailings being stored upstream. It is anticipated that Stage 1 of the TMF dam will be constructed as outlined in Table 2.1. A plan view of the proposed TMF (Stage 1) and polishing pond is outlined in Figure 2.3. Preliminary dam cross-sections for each option are presented in Figure 2.4a and 2.4b.

Table 2.1 North Tributary Tailings Pond Dam – Stage 1 Construction

Crest Width	10 to13 m
Maximum Crest Elevation	385 m amsl
Maximum Dam Height	30 m above ground level (agl)
Dam Length	307 m
Upstream Dam Slope (Horizontal:Vertical)	2.5:1 to 3:1
Downstream Dam Slope (Horizontal:Vertical)	2.0:1
Gravity Material	Glacial till / Rockfill
Impermeable Material	Glacial till / Membrane



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1. WATERCOURSE: NEW BRUNSWICK HYDROGRAPHIC NETWORK 2013-05-06
2. LIDAR CONTOURS: LEADING EDGE GEOMATICS, 2013

PLAN VIEW - PROPOSED NORTH TRIBUTARY TAILINGS POND DAM (STAGE 1) AND POLISHING POND DAM

ENVIRONMENTAL IMPACT ASSESSMENT
CARIBOU MINE, NEW BRUNSWICK

Client: TREVALI MINING (NEW BRUNSWICK) LTD.

Job No.:	121415530.300
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Fig. No.: 2.3

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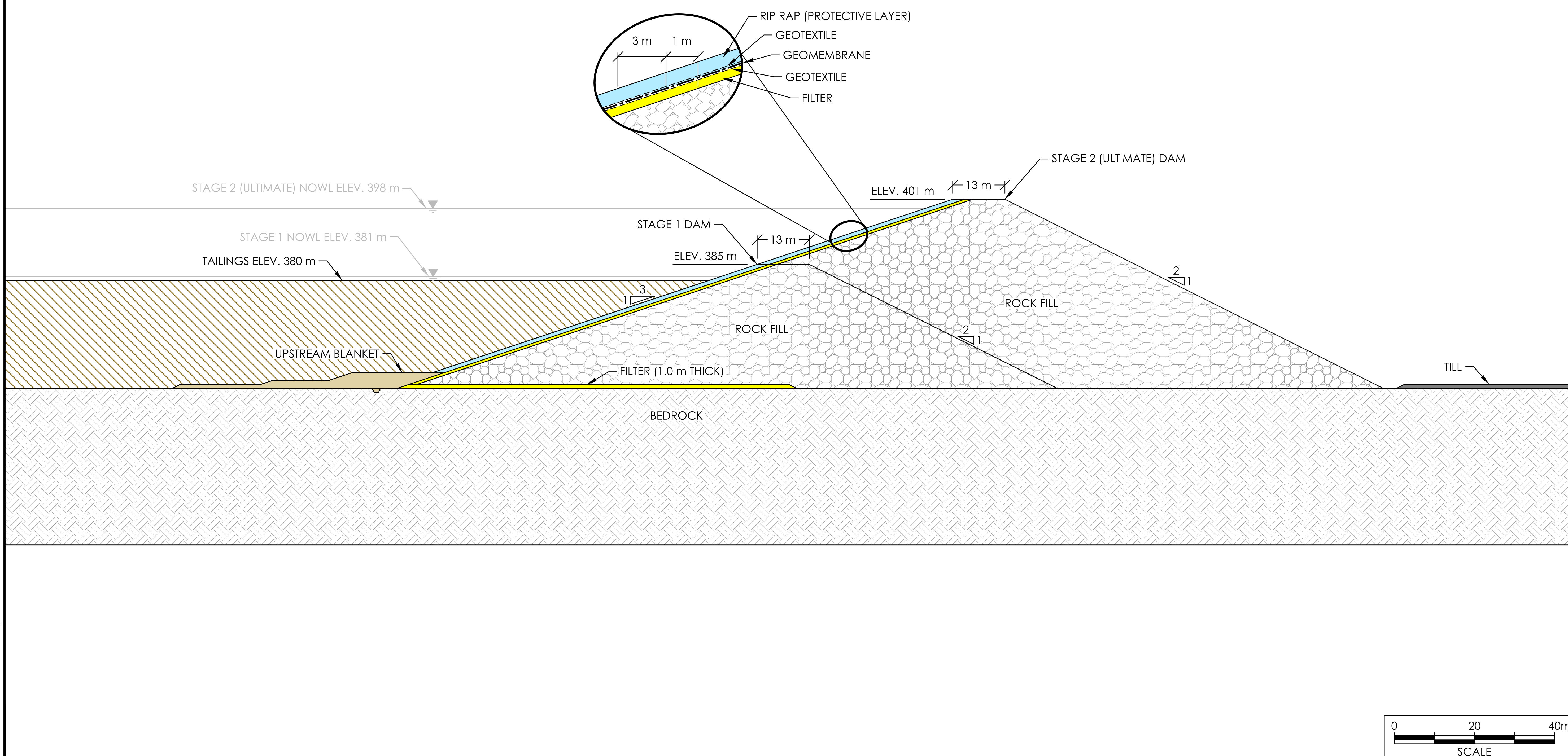

Reference:
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OPTION 1 CROSS-SECTION - NORTH TRIBUTARY TAILINGS POND DAM (STAGE 1 & STAGE 2)

ENVIRONMENTAL IMPACT ASSESSMENT
CARIBOU MINE, NEW BRUNSWICK

Client: TREVALI MINING (NEW BRUNSWICK) LTD.

Job No.:	121415530.300
Scale:	1 : 1000
Date:	12-JUL-2018
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Fig. No.: 2.4A

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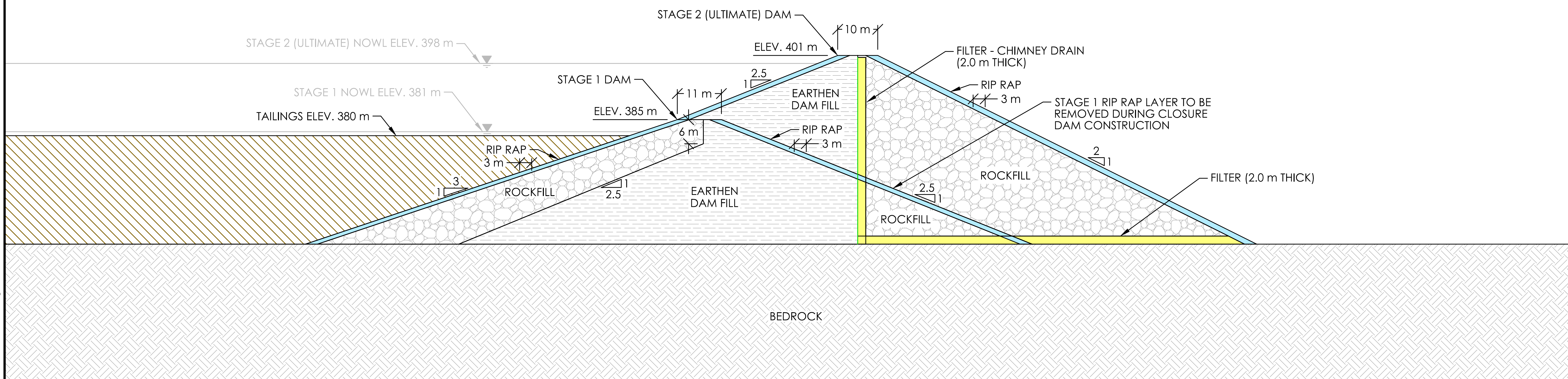

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Reference:
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OPTION 2 CROSS-SECTION - NORTH TRIBUTARY TAILING POND DAM (STAGE 1 & STAGE 2)

ENVIRONMENTAL IMPACT ASSESSMENT
CARIBOU MINE, NEW BRUNSWICK

Client: TREVALI MINING (NEW BRUNSWICK) LTD.

Job No.:	121415530.300
Scale:	1 : 1000
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Fig. No.: 2.4B

Stantec

Details of the dam designs will be confirmed during detailed design. All dam designs will meet the most up to date Canadian Dam Association (CDA) Dam Safety Guidelines. In preliminary design of the NTTP dam (Stantec 2018a), a preliminary dam classification (CDA 2013) has been selected for the NTTP dam of "very high". The rationale for selection of the preliminary dam classification is based on the expected consequences of failure should one occur (mainly environmental considerations and loss of life potential due to temporary non-transient use of the floodplain). This classification is consistent with the previously classified STTP dam (Stantec 2015d) located upstream of the proposed NTTP dam. The selection of the preliminary classification must be confirmed through numerical simulations to analyze the incremental effects of a dam breach and this will be completed as part of detailed design for the Project. As defined by the Canadian Dam Association's Dam Safety Guidelines (CDA 2013) and its Technical Bulletin on Mining Dams (CDA 2014), the corresponding design criteria for the dam classification are outlined in Table 2.2.

Table 2.2 Summary of Dam Classification and Design Criteria

Structure	CDA Dam Classification	Inflow Design Flood	Design Earthquake	Wind AEP
North Tributary Tailings Pond Dam	Very High	2/3 between 1/1,000 AEP and PMF	½ between 1/2,475 and 1/10,000 or MCE	1:2

Legend: AEP: annual exceedance probability; PMF: probable maximum flood; MCE: maximum credible earthquake

2.3.1.2 Polishing Pond and Dam

In addition to the Stage 1 NTTP dam, a new polishing pond dam will also be constructed approximately 380 m downstream of the main TMF dam to capture seepage and allow for effluent treatment/settling. The area upstream of the new polishing pond will be flooded to a normal operating water level of 353 m amsl and will cover an area of 1.1 ha.

2.3.1.3 Water Treatment Facility

The existing mine water treatment plant is located 200 m southwest of the milling complex. All mine contact water from the Caribou mine site is currently stored in a sedimentation pond located near the water treatment plant where it is gravity fed or pumped to the facility, treated and pumped directly into a sludge cell located within the STTP via a dedicated high density polyethylene (HDPE) pipeline. The hydroxide sludge settles and remains in the sludge cell, while the water-permeable perimeter barriers slowly release the treated effluent into the STTP where it is eventually transferred into the polishing pond for discharge to the receiving environment. The lime-based water treatment system adds hydrated lime slurry and flocculant to the effluent in order to adjust the pH and precipitate metals. The water treatment plant building is a metal clad building housing a lime-based treatment facility. The facility is currently designed to treat a maximum of 454 m^3/h (2,000 USGPM). A secondary lime addition system is installed on the western edge of the STTP and serves to provide additional pH buffering capacity. This system is constructed on a concrete slab and is open to the environment. The lime slurry addition system is currently designed to deliver approximately 21 m^3/h (92 USGPM) of lime slurry to the STTP via a floating discharge line.

Current water quality assumptions for the Project are that all mine contact water will require treatment prior to discharge into the environment unless it meets provincial and federal requirements as defined in TMNBL's Approval to Operate and the MDMER. Thus, a new and/or an updated water treatment facility will be required with the construction of the proposed Stage 1 NTTP. Water quality modelling will be completed to determine water treatment facility requirements for the Project.

Water quality modelling for all waters which will be reporting into the new TMF basin will be initiated in the coming months to determine if water treatment will be required, and if additional water treatment capacity is required beyond that currently available at the Caribou mine site. In the event that additional water treatment capacity is required under the new flow regime, additional treatment options will be examined as part of the broader project scope. If a new water treatment plant is determined to be required, it will likely be located within the PDA near the NTTP dam and upstream of the polishing pond. Standard engineering practices will apply in its design and construction.

2.3.1.4 Permanent and Temporary Ancillary Facilities

Tailings Deposition Pipeline

During the ore milling process, tailings are produced as a waste product. Caribou ore is ground so the tailings are fine in nature and are currently pumped approximately 1.5 km from the milling complex to the STTP via a 457 mm (18 inch) diameter HDPE pipeline and deposited subaqueously via a floating pipeline. During the summer months when the pipeline can be moved, tailings are deposited in the shallower areas defined by an annual bathymetry survey. In the winter months while the discharge pipeline is frozen in place, tailings are deposited in a deeper area of the STTP.

Tailings deposition within the proposed NTTP will be similar to the current process. It is anticipated that the current tailings pipeline and associated floating pipeline will be re-located within the new TMF. Tailings will continue to be deposited as per the tailings management plan. Due to the milling complex proximity to the new TMF, the pipeline may run a shorter distance from what is currently the case, with associated reductions in pumping requirements and related energy use.

Reclaim Pumphouse

Approximately 80% of the process water requirement for the milling complex is met by recycling water from the STTP. The reclaim water is pumped via a set of pumps located on the western bank of the STTP approximately 1.5 km from the milling complex. The pump house is a 5 m x 9 m metal Quonset-style building housing two 1,475 m³/h (3,900 USGPM) centrifugal pumps which are driven by 223 kilowatt (kw) (300 hp) electric motors as well as a 65 kW (87 hp) submersible pump feeding the centrifugal pumps. Reclaim water from the STTP is pumped back to the mill through a 457 mm (18 inch) diameter HDPE pipeline.

Three scenarios are currently considered for the reclaim water pumphouse and associated pipelines for the proposed Project:

1. The current reclaim pumphouse will remain at its current location within the STTP and will continue to supply reclaim water to the milling complex.
2. The current reclaim pump installation within the STTP will be re-located adjacent to the new TMF basin.
3. A new decant structure will be constructed within the new TMF basin, which will house a set of submersible reclaim pumps.

Associated pipelines are not expected to differ significantly from current operations and if the reclaim pumphouse is re-located adjacent to the new TMF, it will be expected that the pipeline length may be reduced due to the proximity of the milling complex, again with reduced pumping requirements and associated energy use.

Process water demand is not expected to differ from current operations and reclaim pump locations will be assessed based on proximity to the milling complex, the head to overcome line loses, and serviceability.

Access Road

Currently, the mine site is accessed by a 4 km long gravel access road off provincial Route 180. The current access is serviced and maintained by TMNBL. During Stage 1, it is anticipated that the existing site access road will continue to be used, though minor modifications may be required.

Temporary internal site roads within the PDA area will be designed to provide safe and efficient movement of equipment and personnel throughout the site and have restricted access for all non-mine equipment and vehicles during construction.

Utilities

Electrical power to the Caribou mine site is supplied by NB Power via a 138 kV transmission line feeding the main substation located on the mine site. The 138 kV line feeds into the main substation yard from the south, where it is transformed to 4,160 V. Beyond the main substation, overhead lines are all 4,160 V. The existing reclaim pump station is powered by a 4,160 V/600 V, 200 kVA transformer. The water treatment plant facility is also powered by a 4,160 V/600 V transformer with a 200 A at 600 V main disconnect.

In the event that the reclaim pumphouse is relocated and/or that a new water treatment facility is required near the proposed TMF, it is anticipated that similar electrical requirements as currently will be needed. Utility components and connections will therefore be engineered, relocated, and/or extended as required from the existing grid.

Borrow Sources

The proposed TMF dam construction will require substantive sources of non-acid generating borrow material both for low permeability material and rockfill/filter materials. It is anticipated that aggregate materials will be sourced from both existing borrow sources in and around the Caribou mine site area as well as from new borrow sources (to be determined) in order to construct the proposed TMF dams. Materials will be processed at the borrow sources and trucked to the TMF dam as required.

The location(s) of the borrow source(s) are currently being explored. The use of existing and/or local borrow sources will be preferred over developing new ones in order to limit the environmental effects associated with the development of a new borrow source. It is anticipated that approximately 350,000 m^3 of material will be required for Stage 1, and another 870,000 m^3 of material for Stage 2.

Temporary Buildings and Facilities

Various temporary buidlings may be required to support construction including, site offices, washrooms (e.g. porta-potties), and storage trailers. A temporary power supply may be required to service these temporary buidlings.

Temporary staging areas will also be required to store equipment and materials. The exact locations of temporary buildings and facilities are not yet known, but will be within the PDA.

2.3.2 Stage 2

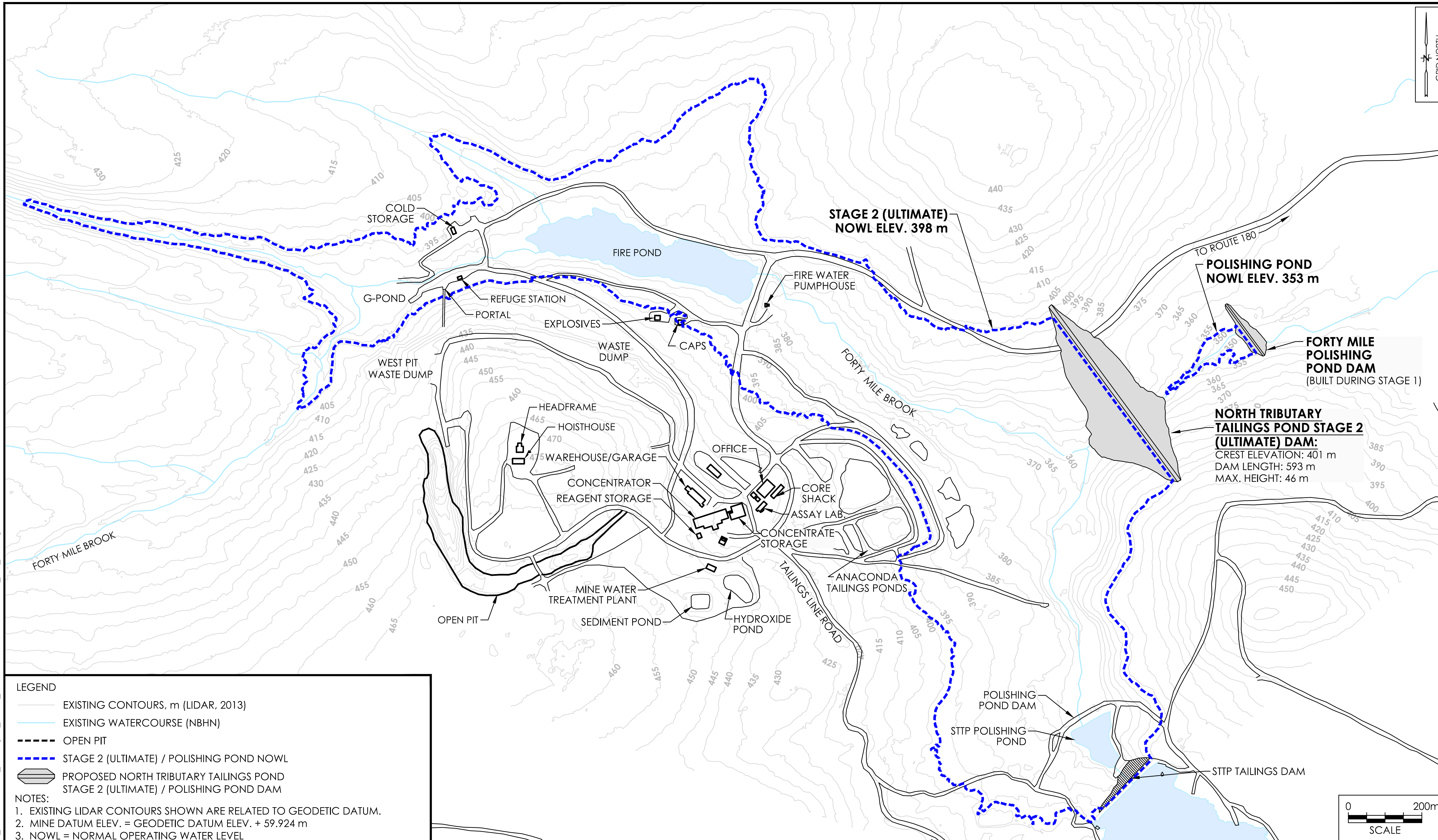
2.3.2.1 Stage 2 TMF Dam Raise, Emergency Spillway, and TMF Basin

Under Stage 2, the Stage 1 TMF dam will be raised by an additional 16 metres, flooding the existing basin to a normal operating water level of 398 m amsl and creating an enlarged basin of approximately 142 ha in size and providing 18.7 million cubic metres (Mm^3) of storage. The dam will be raised either in preparation for site closure, or to enable the continued subaqueous deposition of tailings arising from toll-milling of secondary ores from other local mines, as applicable. The polishing pond and dam constructed under Stage 1 will remain unchanged and will continue to capture seepage and allow for effluent treatment/settling.

The Stage 1 TMF dam will be raised by the downstream method to extend the low permeability core or membrane to achieve the Stage 2 TMF dam crest elevation of 401 m amsl. The emergency spillway constructed during Stage 1 will be filled with concrete and a new emergency spillway meeting the Stage 2 dam requirements will be constructed. It is anticipated that Stage 2 of the dam will be constructed as outlined in Table 2.3. A plan view of the proposed TMF (Stage 2) and polishing pond is outlined in Figure .2.5. Two conceptual options for a Stage 2 TMF dam cross-section were presented in Figures 2.4A and 2.4B, above.

Table 2.3 North Tributary Tailings Pond Dam – Stage 2 Construction

Crest Width	10 to 13 m
Maximum Crest Elevation	401 m amsl
Maximum Dam Height	46 m agl
Dam Length	582 m
Upstream Dam Slope (Horizontal:Vertical)	2.5:1 to 3:1
Downstream Dam Slope (Horizontal:Vertical)	2:1
Gravity Material	Glacial till/Rockfill
Impermeable Material (core)	Glacial till/Membrane



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Reference:

1. WATERCOURSE: NEW BRUNSWICK HYDROGRAPHIC NETWORK 2013-05-06
2. LIDAR CONTOURS: LEADING EDGE GEOMATICS, 2013

PLAN VIEW - PROPOSED NORTH TRIBUTARY TAILINGS POND DAM (STAGE 2)

ENVIRONMENTAL IMPACT ASSESSMENT

CARIBOU MINE, NEW BRUNSWICK

Client: TREVALI MINING (NEW BRUNSWICK) LTD.

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Scale:	1 : 10,000
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Fig. No.: 2.5

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2.3.2.2 Alternative Access Road

Parts of the existing access road to the mine site will be flooded by the Stage 2 NTTP, over time. Therefore, an alternative access road to the Caribou mine site will be required as part of Stage 2 construction. It is anticipated that a new alternative access road will be constructed to the west of the mine site from Route 180. The location of this alternative access road is conceptual at this time and further assessment is required during the mine closure stage as part of the permitting and EIA approval process; however, a conceptual alignment of a potential alternative access road is shown in Figure 2.2. A 20 m wide right-of-way is shown on Figure 2.2 for planning purposes; however, the exact width of the road will be determined during detailed design. All efforts will be made to utilize existing forest resource roads and water crossings for accessing the mine site, in order to limit environmental disturbance. Any new access roads and/or rehabilitated roads will be designed and constructed in consideration of standards for forest resource roads in New Brunswick (NBDNR 2004).

2.4 DESCRIPTION OF PROJECT ACTIVITIES AND STAGES

The stages and activities associated with the Project are described below. The sequencing and methods used for these activities will be confirmed through detailed engineering design, constructability review, and site-specific conditions.

2.4.1 Construction

2.4.1.1 NTTP Dam (Stage 1) and Polishing Pond

Site preparation will include clearing, grubbing, and grading of the Stage 1 NTTP dam footprint as well as a temporary laydown area to support construction. Tree clearing will also be required in the entire TMF footprint, however grubbing will not be required for the TMF basin. The proposed location of a temporary laydown area will be near the dam construction area within the PDA. Its precise location will be determined during subsequent engineering stages. It is conservatively assumed that the entire PDA will be disturbed as part of site preparation. Grubbings and topsoil removed as part of construction will be stockpiled within the PDA or cleared and disturbed areas of the existing mine site for use during closure activities. Timber removed from the PDA will be sold to local markets and stumpage fees will be paid to the province, where applicable.

As part of site preparation, defined construction zones will be established, and signage or barriers will be installed to control access. Existing water and power services into the mine site can be used during construction; however, temporary services may be installed if required. Sanitary waste disposal will consist of on-site portable washrooms (i.e., porta-potties) and supplemented as necessary by facilities within the existing mine site.

To complete the work, it will be necessary to isolate the work site from the watercourse so that work can be carried out under dry conditions. A cofferdam will be installed below the confluence of the north and south tributaries to Forty Mile Brook above the NTTP dam location (Figure 2.6). The cofferdam will be built using a similar methodology as the main dam to maintain the work area in the dry. Any seapage below the cofferdam will be pumped back upstream to maintain dry condition. Prior to installing the cofferdam, the Fire Pond and STTP water levels will be lowered to their lowest operating level so that each basin can be used to maximize water storage during the construction period. These areas will serve as “surge” basins for any flood conditions arising during construction. A combination of diversion options such as pumping and/or diversion channels will be examined as part of the detailed engineering stage of the Project.

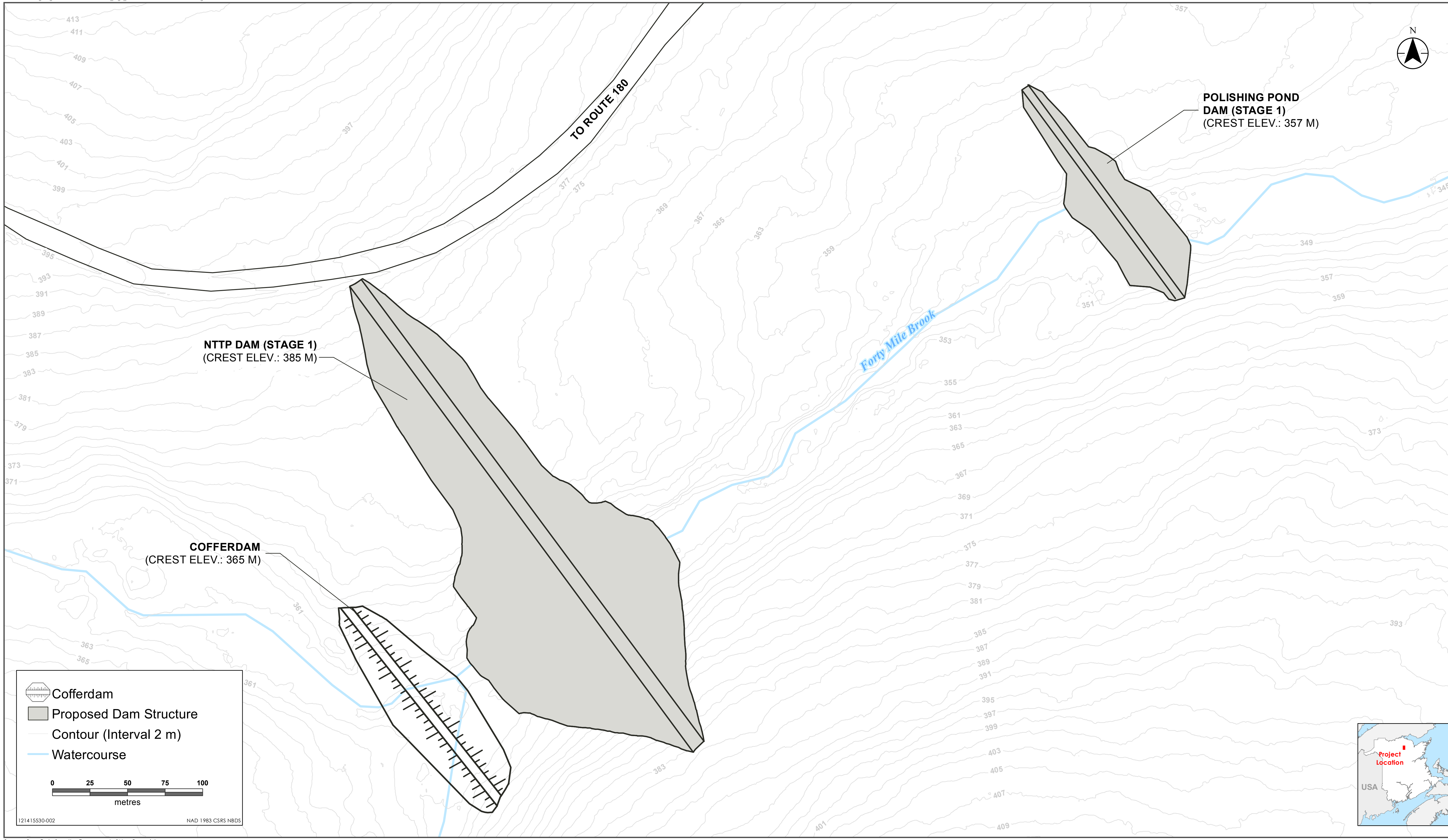
The main TMF dam, emergency spillway and polishing pond will be constructed using locally sourced low permeability material and rockfill. Although these sources have not yet been determined, dam materials will be hauled to the construction area from the designated borrow source(s) via articulated rock trucks and/or highway trucks. If there is a need to process (crushing, sizing, etc.) the dam construction material, this will be done directly at the borrow source location. Dam construction material will be loaded on the trucks using excavators or front-end loaders. The trucks will then proceed to the construction area where they will offload the material in the desired location. The material will be placed using excavators and bulldozers and compacted using compactors. Standard construction procedures are anticipated during the dam construction.

Once the construction works requiring isolation using the cofferdam are complete, selected diversion methods will be removed or decommissioned. The cofferdam will then be breached and water levels in the TMF impoundment allowed to rise to the desired elevations.

Any laydown area(s) located above the flooded basin level will be rehabilitated with the stockpiled grubbing and topsoil material removed prior to construction.

2.4.1.2 Water Treatment Facility

The building for the water treatment will be made of steel construction with metal cladding built on a concrete slab. Mechanical components will be fabricated off-site and trucked to site for installation. Standard engineering practices will apply in its location, design, and construction.



Sources: Base Data from the Government of New Brunswick
Service Layer Credits:

Cofferdam Location

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Figure 2.6

2.4.1.3 Permanent and Temporary Ancillary Facilities

Tailings Deposition Pipeline

It is anticipated that the current tailings and floating deposition pipelines will be re-located within the new TMF. The existing pipeline will be rinsed and drained within the STTP prior to dismantling. The line will be cut into manageable sections using a chain saw and re-located towards the new TMF using heavy equipment. In the event that the line cannot be re-used, a new line will be installed. Some site preparation may be required and will include clearing, grubbing, and grading. HDPE pipe sections will be fused together using a fusing machine and will extend from the milling complex to the new TMF. The floating deposition line will be added to the end of the HDPE tailings pipeline and extended within the new TMF. The tailings line is not anticipated to cross any watercourses and remains within the mine's current property boundaries.

Reclaim Pumphouse

For Stage 1, three scenarios are currently being considered for the reclaim water pumping system. The current reclaim station may be kept as is and continue to provide water to the milling complex. Under this scenario (scenario #1), no additional construction work will be required.

Relocation of the reclaim pumping station (scenario #2) will see it installed near the new TMF area within the PDA and require installation of an HDPE pipe line as per the one in service now. Site preparation for the re-location may include clearing, grubbing, and grading. After dismantling, the existing pumphouse building, reclaim pumps and electrical components will be relocated and installed on a new concrete slab. The old cement slab will be broken up and disposed of in an approved construction waste disposal location or buried on-site.

Construction of a new decant structure (scenario #3) will require preparation of a compacted base within the new TMF where precast concrete forms will be installed to form the decant structure. Submersible reclaim pumps will be installed within the structure.

For both scenario 2 and 3, the existing HDPE piping will be relocated, connected and installed onto the reclaim pumping structure within the new TMF if practicable. If determined to be not practicable due to operational constraints, new reclaim pumps and associated infrastructure will be installed.

At Stage 2, if the mill is closed and decomisioned, the reclaim pump station or decant structure will be decomissioned. Where possible, pumping and electrical equipment will be sold and or recycled in an approved facility. The cement bases will remain and will be flooded under Stage 2.

Access Road

For Stage 1, minimal road construction will be required. An access road branching from the main access will be constructed to approach the construction area. Dependent on the borrow source locations, utilizing existing forestry roads and/or developing new forest access may be required. All efforts will be made to use existing forestry roads and water crossings.

Major modifications to the main mine site access road will be required since parts of the road will be flooded by the Stage 2 TMF. Access from either the north or the south of the property will be examined. All efforts will be made to use existing forestry roads and water crossings. Road locations will be better defined as the closure stage engineering progresses.

Road construction requires the creation of a continuous right-of-way through clearing and grubbing of existing forested areas, and cutting, filling and grading to overcome geographic obstacles and provide grades low enough to permit safe vehicle travel. Right-of-ways will be cleared as required in accordance with guidelines, standards and best practices for developing forest resource roads (NBDNR 2004). Leveling and excavation will be conducted as necessary. Some blasting may be required. The completed roadways will be finished by preparing a stabilized sub-grade with a gravel surface. Fill, gravel, and rock will also be sourced as needed from local sources. Erosion control and dust suppression measures will be implemented to reduce the potential environmental effects of activities on nearby watercourses. Any new watercourse crossing structures installed as part of the Project will be designed, installed, and maintained to support design loadings. A watercourse and wetland alteration permit will be obtained prior to construction for all activities within 30 m of a watercourse or wetland, and permit conditions will be adhered to.

All site access and internal site roads will be designed based on industry accepted practices and according to forest resource road specifications. All site access roads and site roads will be refurbished or constructed in accordance with the Forest Management Manual (Section 4.4 “Roads and Watercourse Crossings” in NBDNR 2004) and have approval from NBDERD. Best management practices for the use of forest roads in New Brunswick will be implemented and a Traffic Plan developed in consultation with the Crown Timber Licence Holders and NBDERD.

Utilities

The possible relocation of the reclaim pumping station and/or the construction of a new decant structure will require power. To service these infrastructures, current utilities will be extended and/or modified to supply power to the Project site from the existing electrical grid. In the event that new overhead powerlines and/or substations are required, site preparation may include clearing, grubbing, and grading to reach the reclaim pumping station and the water treatment plant. It is not currently anticipated that major utility work will be required outside of the PDA nor outside the current mine property boundary.

Borrow Sources

For construction, existing borrow sources will be used, and it is likely that new borrow sources will be developed. Topsoil and overburden will be stockpiled as land is cleared for the borrow source. Excavation and/or blasting methods will be used to extract the borrow material. The material will be processed directly at the site of the borrow material and stockpiled. Excavator(s) or front-end loaders will be used to load haul trucks which will deliver the material to the TMF dam construction area as required.

Best management practices will be applied during the operation of the borrow source by providing dust suppression (if required) of the stockpiled material and access roads. Erosion and sediment control such as settling ponds to manage waters that may contain TSS will also be implemented as required.

Quarry permit(s) and/or lease(s) pursuant to the *Quarriable Substances Act (C. Q-1.1) and Regulation (93-92)* will be applied for prior to commencement of work.

2.4.2 Operation

2.4.2.1 NTTP Dam and Polishing Pond

Once the Stage 1 NTTP dam is complete, the operation phase will begin with the subaqueous deposition of tailings and the recycling of process water to the milling complex. Water levels in the NTTP will be managed within the existing operational limits to maintain a minimum of 1 m water cover over the tailings. Excess water during periods of high flow will be managed by discharging treated water in a controlled manner to the polishing pond. During extreme weather events, excess water will be routed around the dam via the emergency spillway. Water levels in the NTTP headpond will be managed similar to current conditions. Freeboard requirements will be confirmed during detailed design and meet the current CDA Guidelines.

The Operational, Management, and Surveillance (OMS) Manual of the NTTP and associated dams will be completed as per the CDA and Mining Association of Canada (MAC) guidelines. As is current dam safety management practice for the existing dam infrastructure at the Caribou mine site, weekly inspections will be completed on the NTTP dam. Safety procedures such as implementing yearly dam inspection done by qualified engineering personnel as well as dam safety reviews held every 5 to 10 years (frequency varies depending on consequences of failure) will continue to be completed as per CDA guidelines for the NTTP dam (Stage 1 and Stage 2). Routine maintenance of the valve structures and spillway will continue as per current practices.

2.4.2.2 Water Treatment Facility

All mine contact water will continue to be treated as is currently done at the site. Treated mine effluent will be discharged from the outlet of the new polishing pond. Mine effluent will continue to be treated to meet or exceed provincial (Approval to Operate) and federal guidelines (MDMER). Exact details of on-going water treatment operating requirements at the site are not yet known and will be determined based on the results of planned water quality modelling for the Project.

2.4.2.3 Permanent and Temporary Ancillary Facilities

During operation, the reclaim pumps, tailings deposition line, access roads, and power grid will continue to function as is currently found at the site. This infrastructure will continue to be maintained and serviced, as is currently the case.

2.4.3 Closure/Post-Closure

2.4.3.1 NTTP Dam Raise (Stage 2)

The TMF for mine closure/post closure (Stage 2) will be constructed at the end of the current LoM using downstream dam raise methodology and will follow similar construction methods as outlined in Section 2.3.1.1. The Stage 1 spillway will be infilled using concrete and a new emergency spillway will be constructed to meet the new dam height requirements. In the event that satellite ore deposits are found after the current LoM, the milling complex may remain in operation and provide toll-milling services. Under this scenario, the Stage 2 NTTP will be utilized to store tailings from the toll milling.

During closure at the end of current LoM and/or end of satellite deposit processing, the NTTP dam and polishing pond will remain in operation, although tailings deposition and process water demand will cease. During this period, the OMS guidelines as described in Section 2.4.2.1 will continue to apply in perpetuity for the TMF.

2.4.3.2 Water Treatment Facility

At closure, the water treatment facility will remain in operation for a minimum of three years, with provisions for long-term mine water treatment as determined during the initial three years. Water treatment activities will only cease if/when provincial and federal water quality guidelines are consistently met without treatment at the final discharge point. In the interim, the water treatment facility will continue to be maintained and serviced as is currently the case. If water treatment is determined to be no longer required, this facility would be dismanteled.

2.4.3.3 Permanent and Temporary Ancillary Facilities

The dismantling and removal/disposal of associated TMF surface infrastructure (e.g., pumphouse, roads, pipelines, etc.) will not be assessed as part of this study and will be further assessed during the mine closure stage as part of the permitting and EIA approval process required at that time.

Generally, surface infrastructure will either be removed from the property or disposed of off-site, depending upon the nature of the material. Efforts will be made to sell and/or recycle materials in an approved facility. Grading and/or scarification of disturbed areas will be performed to promote natural vegetation, or placement and grading of overburden for vegetation in areas will occur where natural vegetation is not sufficiently rapid to control erosion and sedimentation.

2.5 SCHEDULE

Construction of the Project (Stage 1), subject to the receipt of all necessary permits, approvals and authorizations, is expected to begin in the third quarter of 2021 with the site infrastructure and mobilization. The majority of construction will be completed by the end of the fourth quarter of 2021. Project activities and associated timelines are described further in Table 2.4.

Table 2.4 Preliminary Schedule

Project Component, Phase and Activity	Preliminary Schedule
Planning	
EIA Approval	Q1 2019 (assumed)
MDMER Schedule 2 Ammendment	Q2-2020 (assumed)
Tendering of Various Project Components	Q2 2019
Construction	
Site Preparation	Q3-Q4 2020
Cofferdam Installation	Q3-Q4 2020
NTTP Dam (Stage 1), Polishing Pond Dam	Q3-Q4 2020
Water Treatment Facility	TBD

Table 2.4 Preliminary Schedule

Project Component, Phase and Activity	Preliminary Schedule
Cofferdam Removal	Q4 2020
Commissioning of NTTP Dam (Stage 1)	Q1 2021
Operation	
Operation of NTTP Dam (Stage 1)	2021-2024
Closure	
NTTP Dam Raise (Stage 2)	Year 2025
Commissioning of NTTP Dam (Stage 2)	Year 2025-2026
Operation of NTTP Dam (Stage 2)	Remains in Perpetuity
Water Treatment Facility†	Year 2032
Notes	
†Treatment assumed to be required for 3 years following mine closure, but may be required in perpetuity depending on water quality.	

2.6 EMISSIONS AND WASTE

TMNBL will comply with standards outlined in applicable regulations and guidelines with respect to waste, emissions, and discharges from the Project. Where no standards exist, industry best practices will be adopted, where applicable. Volumes of wastes and concentrations of contaminants entering the environment will be reduced through best management practices, following applicable legislation, and mitigation planning as outlined in TMNBL's Site Specific Environmental Management Plan (TSSEMP; TMNBL 2015).

2.6.1 Air Contaminant Emissions

Air contaminant emissions from the Project will mostly occur during construction. The air contaminant emissions of concern are generally classified as Criteria Air Contaminants (CACs) and include carbon monoxide (CO), nitrogen oxides (NO_X), sulphur dioxide (SO_2), and particulate matter (PM, including its common size fractions PM_{10} and $PM_{2.5}$).

Emissions during construction are generally related to the generation of dust and routine emissions from construction equipment or other construction activities. Equipment used for construction will generally consist of trucks, excavators, bulldozers, graders, backhoes, compactors, and other heavy equipment, similar to what may be seen on many industrial construction sites. Control measures, such as use of dust suppression techniques, will be used as required to reduce the fugitive dust, and routine inspection and maintenance of construction equipment will reduce exhaust fumes. The burning of waste brush/slash material will not be permitted.

The Project, once in operation, will continue to be an active industrial site; there will be few air contaminant emissions arising from its operation. There may be nominal CAC emissions from delivery of supplies and equipment to the site and from routine maintenance activities, which should not be measurable above background levels.

Potential air contaminant emissions during closure will be similar to emissions associated with operations.

An assessment of environmental interactions due to Project-related air contaminant emissions is provided in Section 5.3.

2.6.2 Greenhouse Gas (GHG) Emissions

GHG emissions from the Project will mostly occur during construction. The primary sources of GHGs are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), as carbon dioxide equivalents (CO_2e) as a result of the operation of construction equipment as described above for air quality.

An assessment of environmental interactions due to Project-related GHG emissions is provided in Section 5.3.

2.6.3 Noise and Vibration Emissions

Noise and vibration emissions from the Project will occur primarily during construction. Noise emissions during construction are generally associated with the operation of construction equipment. Construction noise will be intermittent, as equipment is operated on an as-needed basis. Noise sources will be mitigated through the use of mufflers.

During operation, there may be periods of low-level noise emissions from the TMF area, mostly from the reclaim pump(s) operation and maintenance activities. This facility will be designed to comply with applicable noise guidelines. There is no expected source of vibration from the Project during operation.

An assessment of environmental interactions due to Project-related noise emissions is provided in Section 5.3.

2.6.4 Liquid Wastes

Liquid wastes generated during construction include oils and lubricants from the construction equipment. These wastes are considered dangerous goods and will be collected and disposed of in accordance with applicable local and provincial regulations. Other liquid wastes, including sewage and domestic wastewater, will also be collected and disposed of off-site consistent with local and provincial standards.

Liquid wastes typically produced during operation will be primarily from mine contact water. Mine contact water from the Caribou mine site will be collected and directed to the new TMF for storage, reclaim, and/or treatment and discharge, as applicable, in much the same manner as with the existing operation. Surplus water from the TMF will be treated in the water treatment facility as described in Section 2.3.1.3 to meet provincial and federal water quality requirements as described in Section 5.5.

Various oils and lubricants will also be required to support the operation of transformers and other mechanical equipment in the reclaim pumphouse and water treatment facility. Any waste oils and lubricants will be taken to an approved disposal facility by a licensed contractor.

2.6.5 Surface Runoff and Sedimentation

There is potential for erosion and sedimentation of freshwater systems associated with land-based construction activities as well as sediment re-suspension associated with construction activities within the brook channel. The

TSSEMP will be implemented during the Project's construction phase and include plans for erosion and sediment control measures.

2.6.6 Solid and Hazardous Wastes

Solid wastes generated during construction will include rock, debris removed from the clearing of the TMF area, temporary fencing, signs, metal containers, canisters, as well as excess concrete and other construction materials, and domestic wastes. Scrap paper and other office wastes will also be generated. During operation, a limited amount of solid wastes may be generated, such as lubricant containers.

TMNBL will actively cooperate with municipal waste reduction and recycling programs and will encourage conservation throughout construction and operation. Solid wastes will be collected and disposed of in a manner consistent with local and provincial standards. Non-hazardous wastes will be separated as recyclable and non-recyclable, with recyclable material collected and transported to a licensed recycling facility. An effort will be made to reduce the amount of waste generated by the application of 4-R principles (reduce, reuse, recycle, recover) to the extent practical. Waste management procedures are outlined in the TSSEMP and comply with provincial solid waste resource management regulations as well as additional municipal and disposal facility requirements. Non-recyclable wastes will be transported off-site to a permitted landfill.

Dangerous goods will be stored onsite in a separate temporary dangerous goods storage area provided with full containment. Dangerous goods will be removed from the site by a licensed contractor and recycled or disposed at an approved facility.

2.7 ACCIDENTS, MALFUNCTIONS, AND UNPLANNED EVENTS

Accidents, malfunctions and unplanned events will be prevented and mitigated through a systematic approach to environmental protection.

The key accidents, malfunctions and unplanned events that could potentially occur during construction or operation of the Project are described below. Mitigation measures to prevent the occurrence of such events, and response procedures to be implemented in the event they do occur, will be developed prior to the commencement of each Project stage, as applicable.

2.7.1 Loss of Containment from the TMF

A loss of containment from a TMF is defined as a significant failure of a TMF embankment leading to the release of large quantities of mine contact water and/or tailings into the receiving environment. A loss of containment may result from human error, a seismic event, or from extreme weather events.

Considering that the process of conducting site investigations, design, review, construction, operation, closure, and monitoring of a TMF in Canada is well established under guidelines developed by the CDA and by the International Commission on Large Dams (ICOLD), loss of containment is an unlikely scenario. The CDA Guidelines specify that qualified third-party engineering firms conduct site investigations, develop designs, monitor construction, and inspect ongoing operations to ensure that the appropriate standards are met. For the Project, these include the following:

- Design for geotechnical stability for the most significant earthquake loading relating to the largest applicable seismic event (known as the Maximum Design Earthquake);
- Design for safe containment of all rainfall and run-off resulting from the Inflow Design Flood (IDF) at all times during operation and for attenuation and safe passage of the IDF after closure;
- A Failure Mode Analysis by qualified independent specialists to ensure that the TMF embankment design and operating plan adequately address any and all potential failure causes and mechanisms;
- Quality assurance and inspections by the design engineers during initial and ongoing construction of the TMF;
- Monitoring and inspections during operation (including a five-year review under the CDA Guidelines conducted by a qualified geotechnical engineer) to assess TMF performance and to identify any conditions that differ from those assumed during the design; and
- Scheduled, ongoing inspections and audits of the facility by qualified geotechnical engineers during operation and after closure.

With the application of these standards and rigorous construction methods and inspections to ensure the structural integrity of the TMF embankments and components, the implementation of adaptive management measures as necessary over the LoM, and regulatory oversight, the possibility of a structural failure of a TMF embankment is so unlikely that it cannot reasonably be considered a credible accident or malfunction.

2.7.2 Loss of Containment from the Polishing Pond

A loss of containment from the polishing pond is defined as a significant failure of the pond's embankment leading to the release of treated mine contact water into the receiving environment. A loss of containment may result from human error, a seismic event, or from extreme weather events.

Processes as described in Section 2.7.1 will be similarly applied during the design, construction and operation phases of the polishing pond. Therefore, with the application of these standards, a structural failure of the polishing pond is unlikely and cannot reasonably be considered a credible accident or malfunction.

2.7.3 Release of Off-Specification Effluent from the Water Treatment Facility

During operation, any mine contact water will be collected and stored in the NTTP until it is used in the milling complex as process water. During the course of operations, it will be necessary to release contact water that is surplus to Project needs, and it will be treated in a water treatment facility to ensure it meets discharge standards prior to being released to the receiving environment.

A Release of Off-Specification Effluent from the Water Treatment Plant (WTP) consists of the release of wastewater, or effluent, from the PDA into the receiving environment that exceeds MDMER or other effluent quality requirements as defined by approvals or permits to be issued for the Project. This event considers a release of the excess water that, though treated or normally meeting effluent standards, does not meet quality requirements prior to being released to the receiving environment. This situation may result from a mechanical or instrument failure in the water treatment plant, power failure, release via the emergency spillway during an extreme weather event or other means.

All effluent released from the Project will be monitored to verify that it meets MDMER or other effluent quality requirements as defined by the Approval to Operate for the Project. In the event that contaminant limits above the permitted levels are indicated, if there is sufficient retention volume available in the NTTP, the water treatment plant will be temporarily shut down until repairs to the facility can be implemented and/or changes to the treatment process can be implemented in order to meet the permitted levels for effluent release.

2.7.4 Hazardous Materials Spill

A spill of petroleum, oil and lubricants (POLs) or other liquid hazardous materials may occur during any stage of the Project during refueling of machinery or through breaks or leaks in hydraulic lines of equipment. Such spills are usually highly localized and easily cleaned up by on-site crews using standard equipment and spill response materials. In the unlikely event of a spill, soil, groundwater and surface water contamination may occur.

TMNBL and their contractor(s) will take necessary precautions, including the designation of fuel storage and fueling areas according to provincial policy such that construction activities will not result in the release of harmful material or substances and take necessary measures for containing and cleaning up spills which may occur, in a safe and efficient manner, and in accordance with federal and provincial reporting requirements.

2.7.5 Erosion and Sediment Control Failure

Failure of erosion and sediment control measures may occur during the development of the Project. Such an event could potentially result in the release of sediment-laden run-off to receiving watercourses with potential adverse environmental effects to fish and fish habitat.

Standard erosion and sediment control measures, including the use of sediment/silt fencing and check dams, will be utilized where deemed necessary. Inspection and monitoring of erosion and sediment control measures will be conducted regularly during the construction stage of the Project, particularly during and after extreme precipitation events that result in visible overland flow of water. Erosion and sediment control structures found to be damaged will be repaired immediately and any other remedial action will be taken as necessary.

2.7.6 Fire

A fire may occur during any stage of the Project due to an equipment accident, human carelessness, or natural causes such as a forest fire under dry conditions. The immediate concern for a fire will be for human health and safety; additional concerns include habitat loss, direct mortality to wildlife, and loss or damage of property. The emissions from a fire would likely consist mainly of smoke (particulate matter) and CO_2, but could also include CO, NOx, SO_2, and other products of incomplete combustion. A large fire could create air contaminant levels greater than the ambient air quality standard over distances of several kilometres, but such cases would be of short duration and are not expected to occur.

Proper materials management (i.e., of fuel and other hazardous materials) and operational procedures (i.e., storage, handling and transfer) will reduce the potential for, and extent of, accidental Project-related fires. Work permits, under the *Forest Fire Act*, will be obtained prior to construction or as needed for other industrial activities within forested lands. In the unlikely event of a large fire, local emergency response and firefighting capability will be called to respond to reduce the severity and extent of damage and to protect the safety of workers. Fire fighting equipment will be maintained at the work site.

2.7.7 Discovery of a Heritage Resource

Even with the completion of a pre-construction heritage resources assessment, there is the potential for previously undiscovered archaeological or paleontological resources to be encountered during construction activities. Such an unplanned discovery would occur during earth moving and excavation activities such as road construction/upgrades, development of borrow sources and construction of the TMF dam.

To address this possibility, a Heritage Resources Discovery Plan will be developed for the Project. In general, this Plan will state that in the event Project personnel encounter any potential archaeological resources, work in the immediate area of the find will be halted and a buffer (e.g., 10 m radius) will be established around the discovery until it can be properly investigated. If the find is determined to be archaeological in nature, an appropriate mitigation strategy will be developed in consultation with the Archaeological Services Branch of the New Brunswick Department of Tourism, Heritage and Culture, and if the site is related to Indigenous use of the land, that consultation will include the local Indigenous Community and Archaeological Services. Archaeological resources can only be investigated and mitigated by a professional archaeologist permitted by the Province of New Brunswick.

Similarly, in the event that Project personnel encounter any suspected palaeontological resources such as fossils, within the PDA, the Heritage Resources Discovery Plan will note that the *Heritage Conservation Act* requires that such finds be reported to the New Brunswick Museum. Depending on the nature of the discovery, a permit may be required to collect and remove any identified fossils.

2.7.8 Vehicle Accident

A vehicle accident could potentially occur during construction when an anticipated increase in heavy truck traffic around the Project area is likely to occur. Worker and truck traffic to and from the site, and the operation of heavy equipment on-site during construction, have the potential to result in vehicle accidents during construction.

Project-related vehicles will observe all traffic rules and provincial and federal highway regulations. Trucking during construction will take place on designated routes, and traffic control will be implemented if needed, but is not anticipated.

2.7.9 Wildlife Encounter

There is the potential for workers to come into contact with wildlife during the construction and operation of the Project. This could have adverse effects on both worker (e.g., disruption of work activity, or bodily harm) and wildlife (e.g., disturbance of critical life cycles). Frequent human activity in the area of the Project reduces the potential for wildlife encounters (i.e., posing a risk to public or worker health and safety or to the survival of the wildlife). In case of persistent or dangerous wildlife encounters, TMNBL personnel shall notify NBDERD of the situation.

2.8 ENVIRONMENTAL PLANNING AND MANAGEMENT

A variety of environmental protection and management measures will be implemented to guide the planning, design, construction, operation, and closure of the Project. These include, but are not limited to, the following measures.

- Employ 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.
- Continue to implement TMNBL's SSEMP, which contains mitigation measures to avoid and reduce potential adverse environmental interactions that might otherwise occur from routine Project activities, including emergency response and contingency procedures. The TSSEMP includes procedures related to the following:
  - site security and safety;
  - human health and safety;
  - clearing of vegetation;
  - petroleum, oils, lubricants (POL) and hazardous materials storage, handling and disposal;
  - solid waste and effluent management;
  - heritage resources (including procedures for chance encounters of heritage resources during construction);
  - buffer zones;
  - erosion and sediment control;
  - excavation and grading;
  - dewatering and site release;
  - pumps and generators;
  - spill prevention and management;
  - dust and noise management;
  - construction equipment;
  - fire prevention and protection;
  - transportation; and,
  - training, reporting and awareness.
- Prepare and implement Project-specific emergency response and contingency procedures as part of the TSSEMP to advise Project personnel on how to implement specific actions to respond to accidents, malfunctions, or unplanned events, as defined in Section 2.7.
- Complete Indigenous engagement, and public/stakeholder consultation, as described in Chapters 7 and 8, such that, wherever possible, concerns about the Project are accommodated in its design, construction, operation, and closure, and employment, business and other benefits are optimized and realized locally.

3.0 ALTERNATIVE MEANS OF COMPLETING THE PROJECT

TMNBL and its team considered a wide range of alternative means of providing additional tailings storage capacity for the Caribou mine during preliminary engineering design and scoping studies completed for the Project. The purpose of examining alternative methods is to identify preferred technologies, methods, designs, and siting options for the Project taking into account environmental, economic, and technical factors.

A summary of the screening assessment completed to identify feasible alternative technologies and associated alternative siting locations is provided below.

3.1 WHY IS A NEW TMF REQUIRED?

As discussed in Section 1.2, the STTP has an estimated remaining tailings storage capacity equivalent to approximately two - three years, at current production rates. Since the Caribou mine has a remaining mine life of approximately 5-6 years based on reported reserves, and in consideration of the potential to develop other nearby satellite mineral deposits that will require processing at the Caribou mill, additional tailings storage capacity is required.

3.2 CONSIDERATION OF ALTERNATIVE TECHNOLOGIES

When evaluating options for continuing mine operations after the STTP has reached capacity, TMNBL considered several alternative tailings disposal methods that were determined to be potentially feasible given the nature of existing operations and site constraints. The alternative technologies considered for managing tailings from the Caribou mill are provided in Table 3.1.

Table 3.1 Alternative Technologies Considered for Managing Tailings from the Mill at the Caribou mine.

#	Alternative Technology	Decription
1	In Pit - Thickened or Paste Tailings	This alternative will backfill the Caribou mine east open pit (labeled “OPEN PIT” in Figure 2.1) with dewatered tailings that are thickened with cement.
2	In Pit - Slurried Tailings	This alternative will be similar to above in that it will backfill the existing east open pit; however, it will deposit untreated slurried tailings (i.e., tailings diluted with process water).
3	Underground Backfill - Paste Tailings	This alternative will backfill underground portions of the Caribou mine with dewatered tailings that are thickened with cement.
4	Underground Backfill - Co-Disposal of Tailings and Waste Rock	This alternative will backfill underground portions of the Caribou mine with waste rock (i.e., coarse rock with limited mineral content that is not milled as part of the mining process) interspersed by dewatered tailings. Waste rock from historical mining operations is currently being disposed of underground as part of existing operations.
5	Surface Disposal - High-Density Thickened Tailings and Paste Tailings	This alternative will involve the creation of a new tailings impoundment area on the surface, where dewatered tailings thickened with cement will be stored dry on the ground surface (not subaqueous).

#	Alternative Technology	Decription
6	Surface Disposal - Filtered Tailings	This alternative will be similar to above in that it will require a new tailings impoundment area on the surface; however, tailings will only be dewatered (not thickened) and stored dry on the ground surface (not subaqueous).
7	Impoundment - Slurried Tailings	This alternative will involve the creation of a new tailings management facility, or the expansion of the existing STTP, to allow for slurried tailings to be stored subaqueously. This option includes the Project as described in Chapter 2.
8	Impoundment - Thickened Tailings	This alternative will be similar to above in that a new impoundment will need to be constructed (or the STTP expanded); however, the tailings will be thickened prior to disposal. This alternative will involve partial subaqueous storage; however, the thickened tailings will pile and extend above the water's surface (i.e., tailings beaching), therefore reducing the size of the impoundment that is required.

These candidate alternatives were analyzed and screened based on the following criteria, which were determined to be necessary in order for the alternative to be feasible:

1. Does the alternative have storage capacity for a significant percentage of total tailings?
2. Will the alternative present a risk to the safety of mining operation?
3. Will the alternative preclude future exploration or mining of a potential resource?
4. Does the alternative rely on unproven technology or lack a needed function?
5. Will the alternative result in negative life of Project economics?

The results of this screening are presented below in Table 3.2. Based on the results of the screening completed, the only candidate alternative technology that can be demonstrated to meet all of the screening criteria is 'Impoundment – Slurried Tailings' and therefore it was carried forward for further characterization and evaluation.

Table 3.2 Analysis of Candidate Alternative Tailings Disposal Methods

		Candidate Alternatives							
		In Pit - Thickened or Paste Tailings	**In Pit - Slurried Tailings**	**Underground Backfill - Paste Tailings**	**Underground Backfill - Co-Disposal of Tailings and Waste Rock**	**Surface Disposal - High-Density Thickened Tailings and Paste Tailings**	**Surface Disposal - Filtered Tailings**	**Impoundment - Slurried Tailings**	**Impoundment - Thickened Tailings**
Screening Criteria	**Does the alternative have capacity for a significant percentage of total tailings?**	No	No	No	No	Yes	Yes	Yes	Yes
	Will the alternative present a risk to the safety of mining operation?	Yes – the existing pit has hydraulic connection with underground mining	Yes – the existing pit has hydraulic connection with underground mining	No	Yes – considered incompatible with existing mining methodology	No	No	No	No
	Will the alternative preclude future exploration or mining of a potential resource?	Yes – the east pit overlays potential resources and will prevent underground mining	Yes – the east pit overlays potential resources and will prevent underground mining	No	No	No	No	No	No
	Does the alternative rely on unproven technology, or lack a needed function?	No	No	No	Yes- this method is typically only completed where mining activity is no longer performed	Yes – high sulphur content in tailings require subaqueous storage	Yes – high sulphur content in tailings require subaqueous storage	No	Yes – high sulphur content in tailings require subaqueous storage
	Will the alternative result in negative "life of Project" economics?	Yes	No	Yes	Yes	Yes	Yes	No	No

NOTES:
Green coloured cells indicate the candidate technology meets the screening criteria.
Red coloured cells indicate the candidate technology does not meet the screening criteria.

3.3 CHARACTERIZATION OF SELECTED ALTERNATIVE – IMPOUNDMENT – SLURRIED TAILINGS

Following the screening assessment, the Impoundment – Slurried Tailings alternative was further characterized to consider potential options for how this method could be implemented. This review considered the expansion of the existing STTP (which is also a slurried tailings impoundment) by raising its dams, as well as several alternative locations for a new TMF. The potential new TMF locations considered are the NTTP (described in Chapter 2) and seven other TMF locations (Figure 3.1).

In considering these potential TMF options, the following criteria were used:

- The proposed location will need to provide at least 4 million m³ of storage without the need for extensive perimeter dams.
- Preference will be given to TMF locations that are proximal to the mine site to reduce pumping and/or transport requirements.
- Preference will be given to options located within TMNBL-owned property or the existing TMNBL surface lease, and options that have less of an effect on adjacent land users.
- Preference will be given to locations that are located in the Forty Mile Brook watershed, as it is already impaired by past mining activities.
- Preference will be given to options that address historical ARD issues at the site.
- Preference will be given to options that support eventual mine closure.
- Preference will be given to options that can be expanded in the future, should TMNBL decide to use the new TMF for other nearby satellite mineral deposits requiring tailings disposal.

Expansion of the STTP will require a minimum 2 m dam raise to increase the storage volume to reach the current LoM. The STTP dam was previously raised in 1992 and again in 2008. Based on site constraints, an upstream raise of the STTP is not considered feasible therefore a downstream raise was carried as the preferred option. In addition to raising the STTP dam, this option could require raising the Caribou Lake dam, and will require constructing additional saddle dams. The existing water diversion channel will also need to be modified, as it is within the required footprint of the raised STTP. Raising the Caribou Lake dam may require a raise in the lake water level, and because this lake is a popular recreational fishing area by special permit, it is anticipated changes to this water feature will be subject to increased regulatory scrutiny. Despite these constraints, a downstream STTP dam raise is currently believed to be technically feasible though it does not address closure concerns; however, this is being verified as part of ongoing engineering study of this option. This option does have the benefits of being within the existing surface lease, being limited to the Forty Mile Brook watershed, however it would not likely include sufficient capacity for further expansion should TMNBL wish to continue operating the mill following the LoM for producing concentrates from other nearby satellite ore deposits. This option will not meet the criteria of addressing existing ARD issues downstream of the mine, nor will it enhance the site to support eventual mine closure. Although ongoing engineering is examining ways to incorporate these criteria into the STTP dam raise option, as it currently stands, this option is not considered be a viable long-term solution for tailings management at the site.

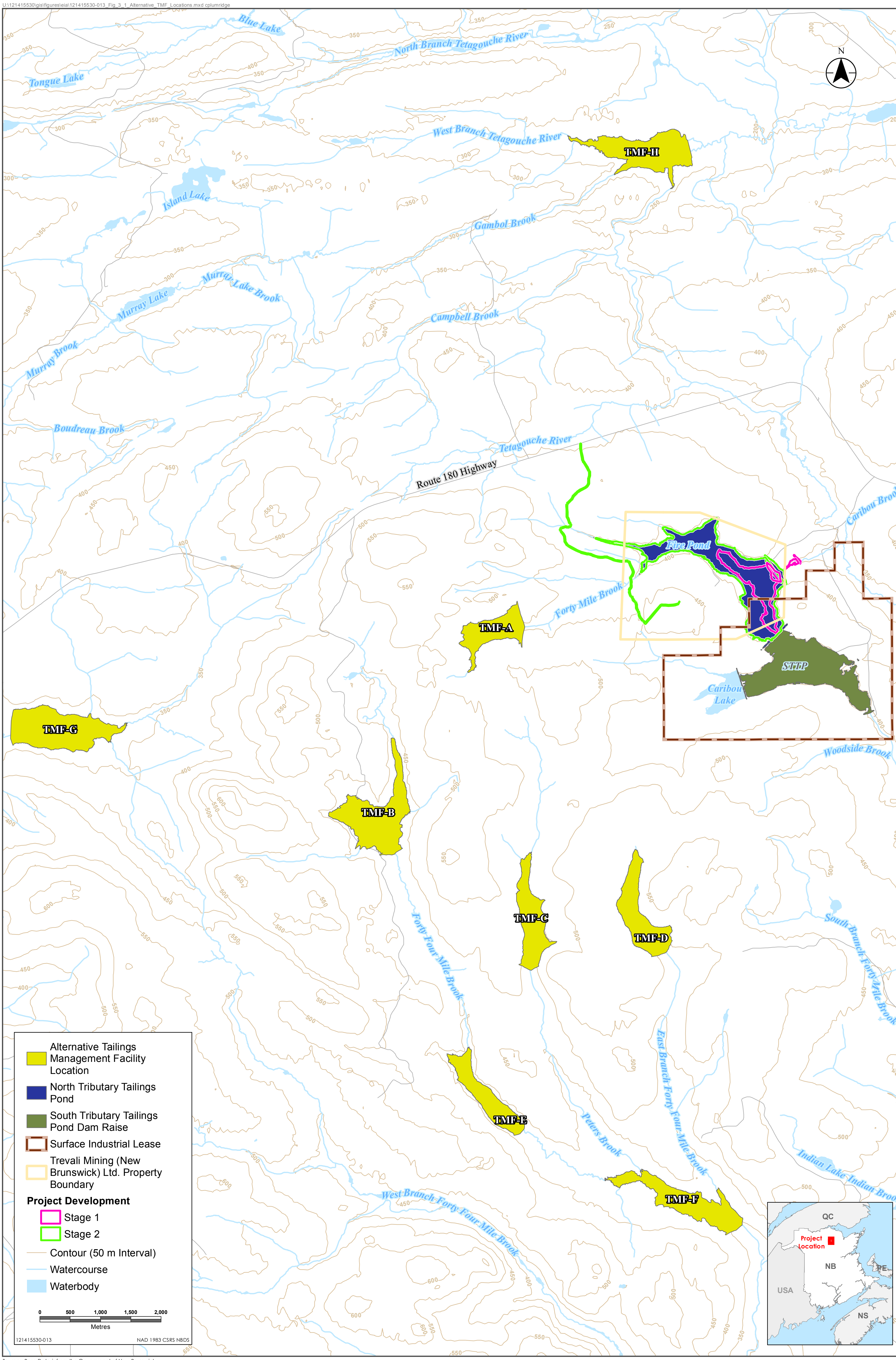
Since slurried tailings was determined to be the preferred deposition method, seven locations (excluding NTTP and the STTP dam raise) were identified meeting the storage volume requirements and are shown in Figure 3.1. These TMF locations have sufficient capacity to store the tailings up to LoM and disposal from other mineral deposits. However, other than the NTTP, these sites are considered not feasible for the following reasons:

- All sites are located outside of the existing property boundaries requiring new surface leases and land use agreement with the Province;
- All sites are located further from the mine site, requiring more complicated transportation solutions for tailings, with corresponding increased energy and/or transportation costs for disposing of tailings as compared to current condition;
- These locations may be located within fish bearing waters outside of the Forty Mile Brook watershed; and
- These loctions will not address ARD issues at the site, nor will they support eventual mine closure objectives.

Based on above assessment criterion, it was determined that these seven alternative locations are not viable options for tailings management.

Ultimately it was determined that the NTTP will be the preferred option for the tailings management as it meets the majority of the selection criteria provided above. During Stage 1, this option will provide 2.8 Mm^3 of tailings storage, and later could be expanded to provide additional tailings storage by raising the TMF dam in Stage 2. With the exception of small portions of the PDA, the NTTP is within TMNBL-owned property, simplifying the requirements for landowner agreements. The NTTP is within a portion of Forty Mile Brook that is not fish-bearing due to historical water quality issues from the mine prior to TMNBL ownership. This option has the benefits that it will address existing ARD runoff at the site, and a TMF dam raise in Stage 2 may potentially also provide a “walk-away” closure scenario of the Caribou mine. Based on the above assessment, the NTTP is currently the preferred tailings management solution for the Caribou mine.

U:\121415530\gis\figures\eia\121415530-013_Fig_3_1_Alternative_TMF_Locations.mxd cplumridge



Sources: Base Data is from the Government of New Brunswick.

Alternative Tailings Management Facility Locations

Stantec

121415530 - TREVALI MINING (NEW BRUNSWICK) LTD.

Figure 3.1

4.0 ENVIRONMENTAL SETTING

The Project is located in Restigouche County, in northern New Brunswick. The area is very remote and consists of significant forest stands and mineral deposits within large tracts of Crown land. The Project is located in the traditional territory of the Mi'gmaq people. For thousands of years, the Indigenous people from adjacent coastal communities used the interior waterways to hunt, fish, and travel overland. By the early 1800s, Europeans began to explore the interior areas and exploit the forests in more accessible areas for lumber (NBDNR 2007). The area also contains mineral deposits that have been explored and mined since the early to mid-1900s. Aside from the use of the area for natural resources, it is sparsely populated. The main economic drivers in the area are forestry and mining.

Further details on the physical, biological, and socioeconomic setting of the Project are provided below.

4.1 PHYSICAL SETTING

4.1.1 Physiography, Bedrock Geology, and Surficial Geology

The Project is located in the northeastern portion of the Northern Miramichi Highlands physiographic region of New Brunswick (Rampton et al. 1984). Rampton attributes the following description to Gauthier (1983), "*In this region are found the highest summits of New Brunswick, they form a central undulating high plateaus within an average elevation well above 600 m*." Streams in this region are deeply incised and are situated between rounded peaks joined by broad ridges (Rampton et al. 1984).

Regionally, the bedrock geology is mapped as consisting of the mafic and felsic volcanic rock of the California Lake Group in the northwest, and felsic volcanic rock of the Tetagouche Group in the south. Both of these groups are of Middle Ordovician age, and consist of metamorphosed volcanic and sedimentary rocks. The Caribou ore body is situated in a massive sulphide deposit, and has a high potential for ARD.

The surficial geology in the area consists of exposed bedrock in north, and mainly stoney till morainal sediments in the south, in the vicinity of the STTP (Rampton et al. 1984).

4.1.2 Topography and Drainage

The Project is situated over Forty Mile Brook, which drains water upstream to the north of the Caribou mine. The topography of the Caribou mine site varies from a high of 480 m amsl in the vicinity of the headframe and hoist room for the mine, to 350 m amsl at the deeply incised Forty Mile Brook channel under the proposed NTTP dam. Regionally, Forty Mile Brook drains to the southeast into the Nepisiguit River, approximately 35 km downstream of the proposed NTTP dam.

4.2 BIOPHYSICAL SETTING

4.2.1 Atmospheric Environment

The current climate conditions are generally described by the most recent 30-year period (1981 to 2010) for which the Government of Canada has developed statistical summaries, referred to as climate normals (GOC 2018). The closest weather station to the Project with available historic data is the Bathurst weather station, located approximately 47 km east of the Project.

A summary of the key climate normal statistics for temperature and precipitation for 1981 to 2010 at the Bathurst weather station is presented in Table 4.1. Based on the climate normals, the average daily temperature at the Bathurst weather station ranged between -10.8°C (January) and 19.1°C (July) (Table 4.1). The extreme maximum temperature was 37.4°C (June 2003) and the extreme minimum temperature was -35.6°C (January 1994) (GOC 2018). Further information on the climatology of the Bathurst area is provided in Section 5.10.

Table 4.1 Air Temperature and Precipitation Climate Normals, Bathurst, New Brunswick (1981-2010)

Month	Temperature (°C)					Precipitation					Mean No. of Days with							
	Averages			Extreme		Rainfall (mm)	Snowfall (cm)	Precipitation (mm)	Extreme Daily Rainfall (mm)	Extreme Daily Snowfall (cm)	Temperature (°C)				Snow (cm)		Rain (mm)	
	Max	Min	Avg	Max (Year)	Min (Year)						>=30*	>=20*	<=-20	<=-30	>=10	>=25	>=10	>=25
Jan	-5.5	-16.2	-10.8	13.1 (2005)	-35.6 (1994)	19.8	72.3	85.1	25.6	54.4	0	0	10.3	1.1	3.1	0.25	0.75	0.13
Feb	-3.7	-15.1	-9.4	14.5 (1994)	-33.4 (2008)	11.6	60.3	66.5	28.5	55.2	0	0	7.6	0.44	2.1	0.56	0.50	0.06
Mar	1.5	-9.0	-3.8	19.6 (1993)	-29.3 (2006)	20.3	70.9	88.8	26.0	56.0	0	0	2.5	0	2.9	0.47	0.65	0.06
Apr	8.3	-1.9	3.2	26.1 (2009)	-19.6 (2003)	48.0	29.2	77.7	30.8	27.2	0	0.76	0	0	0.94	0.06	1.4	0.18
May	15.7	3.6	9.7	31.9 (2004)	-4.7 (2003)	101.1	2.0	103.1	49.5	11.0	0.35	6.5	0	0	0.06	0	3.2	0.65
Jun	22.2	9.5	15.9	37.4 (2003)	-1.9 (2000)	96.9	0.0	96.9	46.6	0.0	2.5	19.8	0	0	0	0	3.2	0.88
Jul	24.8	13.2	19.1	34.8 (1999)	4.4 (1992)	100.8	0.0	100.8	47.0	0.0	3.1	27.2	0	0	0	0	4.1	0.44
Aug	24.3	12.1	18.2	36.2 (1995)	2.3 (2003)	82.0	0.0	82.0	54.2	0.0	2.7	26.3	0	0	0	0	2.7	0.67
Sep	19.6	7.4	13.5	35.4 (2010)	-2.5 (1995)	84.2	0.0	84.2	64.0	0.0	0.41	13.2	0	0	0	0	2.9	0.76
Oct	11.8	1.7	6.8	30.0 (2005)	-7.8 (2008)	115.6	7.3	122.9	96.3	33.6	0	1.5	0	0	0.24	0.06	3.7	1.1
Nov	4.9	-3.4	0.8	22.6 (2008)	-20.0 (1992)	80.6	24.4	103.8	52.0	24.2	0	0.24	0	0	0.71	0	2.7	0.59
Dec	-1.5	-10.4	-6.0	14.0 (1993)	-28.1 (2008)	34.5	67.2	98.4	34.0	41.6	0	0	2.5	0	2.3	0.41	1.4	0.29
Annual	10.2	-0.7	4.8	-	-	795.4	333.5	1,110.1	-	-	9	95.6	22.9	1.6	12.2	1.8	27.1	5.8

NOTES:
Max = maximum
Min = minimum
Avg = average
SOURCE: GOC (2018)

The New Brunswick Department of Environment and Local Government (NBDELG) publishes an annual report summarizing air quality monitoring results in the province. Based on a review of the most recent air quality monitoring report entitled "Air Quality Monitoring Results 2015" (NBDELG 2017), the air quality in northern New Brunswick is generally considered to be good to very good, primarily because of a lack of concentrated heavy industry in the area. The closest NBDELG-operated air quality monitoring station to the Project is located in Bathurst. Ground-level ozone (O_3), nitrogen dioxide (N_2O) and particulate matter less than 2.5 microns ($PM_{2.5}$) are measured at the Bathurst station. There have been no exceedances of the ambient air quality standards at Bathurst station in 2012, 2013, 2014 or 2015 for ozone, nitrogen dioxide, or $PM_{2.5}$ (NBDELG 2017). Ambient air quality data for 2016 are not yet available.

Currently, New Brunswick's contribution to the national total releases of air contaminants is relatively low, approximately 1.21 to 3.46 % of the national total (ECCC 2017b), and its contribution to Canada's greenhouse gas emissions is approximately 1.9% (ECCC 2017b).

Sound pressure levels near the Project are characterized by industrial sounds from the operation of the existing Caribou mine and mill, typical rural sounds including light traffic, and natural sounds such as wildlife.

Further information on air quality, GHG emissions, and noise are provided in Section 5.3.

4.2.2 Fish and Fish Habitat

The Project is located in the Forty Mile Brook watershed which is part of the Nepisiguit River watershed. The Nepisiguit River is typical of northern New Brunswick, both upstream and downstream of Nepisiguit Falls. It is characterized by flowing habitats and islands created through depositional materials, and riparian habitat consists primarily of forested land. The Nepisiguit Falls Generating Station (NFGS) forms a headpond approximately 4 km above Nepisiguit Falls, with more lake-like conditions. Forty Mile Brook is located upstream of Nepisiguit Falls and the headpond. The Caribou mine is located between the north and south tributaries to Forty Mile Brook, with their confluence immediately downstream of the mine site. The quality and quantity of fish habitat in the area has been highly influenced by past mining activities.

The Nepisiguit River has over twenty fish species (GNB 2017, Stantec 2013, Carr 2006; Courtney et al. 2002; Scott and Crossman 1978), including a number of diadromous species present downstream of the Nepisiguit Falls, such as Atlantic salmon (*Salmo salar*) and American eel (*Anguilla rostrata*) (Nepisiguit Salmon Association 2011-2017; Stantec 2013).

Nepisiguit Falls presents a natural barrier to fish passage and no anadromous species are found upstream of the falls or the NFGS. The fish community in the Nepisiguit River upstream of Nepisiguit Falls consists of brook trout (*Salvelinus fontinalis*), blacknose dace (*Rhinichthys atratulus*), brook stickleback (*Culaea inconstans*), common shiner (*Luxilus cornutus*), creek chub (*Semotilus atromaculatus*), lake chub (*Couesius plumbeus*), northern redbelly dace (*Chrosomus eos*), nine-spine stickleback (*Pungitius pungitius*), pearl dace (*Margariscus margarita*), slimy sculpin (*Cottus cognatus*), three-spine stickleback (*Gasterosteus aculeatus*), white sucker (*Catostomus commersonii*) and occasionally American eel (Stantec 2018b; Connell, C., pers. comm., 2017; Stantec 2015a; Stantec 2013; Stantec 2011). American eel is unique in that they can ascend wetted vertical surfaces (Legault 1988) and are occasionally found upstream of Nepisiguit Falls (Nepisiguit Salmon Association 2011-2017; Stantec 2013).

Upstream of Nepisiguit Falls, brook trout are the primary species which support recreational fisheries (GNB 2017).

More details on fish and fish habitat are provided in Section 5.6.

4.2.3 Surface Water and Groundwater

The entire footprint of the Caribou mine is located in the headwaters of Forty Mile Brook (total watershed area of 220 km^2) which includes the north and south tributaries that eventually drain into the Nepisiguit River (total watershed area of 3,100 km^2) (Stantec 2018c). The total watershed area at the proposed NTTP dam location is 28.5 km^2, while the mean annual flow is 0.64 m^3/s based on prorated flows for the nearby Northwest Miramichi at Trout River (Station 01BQ001) between 1961 and 2012 (Stantec 2018c).

The main water features of the existing Caribou mine site include Caribou Lake, the STTP, G Pond, the existing diversion channel, and the Fire Pond. These existing features are man-made and influence surface water quantity in the area, functioning to either provide water for mine processes or manage flows around the site. Caribou Lake is located near the headwaters of the south tributary to Forty Mile Brook and was originally created in 1989 to compensate for the construction of the STTP. The STTP serves to subaqueously store tailings from the milling process and is also used for process water make-up. Outflow from the STTP is regulated to Forty Mile Brook using valves and is managed according to operational and seasonal requirements. The Fire Pond was originally created as a fire protection pond but is now also used to supplement the mine's process water requirements.

Water quality in Forty Mile Brook is characterized by using water quality records from the Environmental Effects Monitoring (EEM) reports completed in 2014 and 2017 for areas located within the Forty Mile Brook and Nepisiguit River watersheds. Water quality in the upper portions of Forty Mile Brook (upstream of the Caribou mine) is characterized as being natural or un-impacted by mining. Water quality below the Caribou mine STTP area is noted to be typical of treated mine water effluent, containing trace metal concentrations that meet MDMER limits but with several parameters in excess of the Canadian Council of Ministers of the Environment's (CCME) "Canadian Environmental Quality Guidelines: Water Quality Guidelines for the Protection of Aquatic Life (Freshwater)" (CCME 1999a, hereinafter referred to as the CCME FAL guidelines), including aluminum, cadmium, copper, lead, nickel and zinc. Historical pre-Trevali mining activities at the site have severely impaired the water quality and fisheries resources extending to the lower portions of the north and south tributaries to Forty Mile Brook all the way down to the confluence with the Nepisiguit River (Stantec 2018b; Stantec 2015a; Currie 1988; Montreal Engineering 1980; Jacques Whitford 1997; Jacques Whitford 1996; Anaconda Company 1976; Environment Canada 1972-1975). Water quality in these areas are characterized by elevated aluminum, cadmium, copper, and zinc when compared to other locations. Additional information on surface water quality and quantity is provided in Section 5.5.

Groundwater quality is characterized by monitoring wells located throughout the Caribou mine site, which are monitored twice yearly. The majority of the wells show elevated trace metal concentrations and lower pH, further supporting that historical tailings areas and ARD waste rock stockpiles are adversely affecting groundwater near the mine site. Further information on groundwater quality is provided in Section 5.4.

4.2.4 Terrestrial Environment

The Project is located on the border of the Tetagouche Ecodistrict within the Northern Uplands Ecoregion, and the Ganong Ecodistrict within the Highlands Ecoregion, located just south of the Caribou mine (NBDNR 2007).

The Northern Uplands Ecoregion arcs across the northern most portion of New Brunswick and is seated between the two separate ecodistricts of the Highlands Ecoregion. The vegetation and fauna within this ecoregion consequently display a mixture of northern and southern affiliations, giving the area an ecologically distinctive character. The vegetation in the Tetagouche Ecodistrict is largely coniferous forest consisting mainly of balsam fir (*Abies balsamea*), with some white spruce (*Picea glauca*) and black spruce (*Picea mariana*). Stands dominated by eastern white cedar (*Thuja occidentalis*), white spruce, and black spruce are found on wet sites along rivers and moist gently sloping flatlands. Intolerant hardwood species include white birch (*Betula papyrifera*) and trembling aspen (*Populus tremuloides*) (NBDNR 2007).

The Ganong Ecodistrict has the lowest annual average temperatures in New Brunswick, due to its higher elevations, and the resultant cold, wet climate. Balsam fir and black spruce dominate the forest, with balsam fir being more prevalent in the northern terrain. This ecodistrict displays boreal and subarctic elements which yield an unusual assemblage of flora and fauna (NBDNR 2007).

The area around the Project site is primarily immature hardwood and softwood stands, with areas which have been more recently cut by the forestry industry, and/or cleared by resource development projects and wind-energy developments. The variety of habitats, ranging from open edge, waterbodies, and varying successional stages of standing forest is expected to provide resources for a variety of wildlife species typical of northern New Brunswick.

4.3 SOCIOECONOMIC SETTING

The Project is located in the unincorporated community of Caribou Depot, in Restigouche County. The area is part of Chaleur Regional Service Commission 3 and the Northeast Economic Region of New Brunswick (comprised of Restigouche, Gloucester, and Northumberland Counties). The city of Bathurst is approximately 45 km east of the Project in Gloucester County and is the largest nearby populated centre.

4.3.1 Economic Activity and Economic Drivers

Historically, economic activity in the Northeast Economic Region of New Brunswick was built on natural resource sectors such as agriculture, forestry, fishing, and mining (NBPETL 2013). In 2016, the healthcare and social assistance industry was the largest in the region, followed by the retail trade industry. Employment in agriculture and forestry make up approximately 7% of the total employment in the region, while approximately 2% of the total employment is in the mining, quarrying, and oil and gas extraction industries. Unemployment in the Northeast Economic Region of New Brunswick is higher than the provincial average (11.2%), ranging from 15.3% in Gloucester County to 19.1% in Northumberland County (Statistics Canada 2017).

4.3.2 Land Use

The land in the general vicinity of the Project is a mix of Crown land and private properties, with a variety of historic land uses including resource development, and forestry. Given the amount of forested area in the region, recreational activities such as hiking, camping, hunting, and fishing are common. The Project is located within an existing mining lease on private property held by TMNBL; access to this area is restricted to mine personnel.

4.3.3 Infrastructure and Services

The Northeast Economic Region of New Brunswick has the lowest population density in New Brunswick. In 2011, the three major cities in the region, Campbellton (Restigouche County), Bathurst (Gloucester County), and Miramichi (Northumberland County), account for less than a quarter (23.6%) of the regional population. Rural populations in parishes and rural communities account for almost half (44.5%) of the population, with the rest of the population (30.3%) residing in small towns and villages (NBPETL 2013). The total population of the Northeast Economic Region of New Brunswick was 154,351 in 2016, and the population of the city of Bathurst was 11,897 (Statistics Canada 2017).

As a predominantly rural area, the Northeast Economic Region of New Brunswick has less public infrastructure and services than urban areas (NBPETL 2013). Emergency services in the Project area are provided by the Bathurst RCMP detachment (RCMP 2018). The Vitalité Health Network provides health services in the area. The closest hospital is the Chaleur Regional Hospital, located in Bathurst, which provides 24-hour emergency service (Vitalité Health Network 2018).

5.0 ASSESSMENT OF ENVIRONMENTAL INTERACTIONS

5.1 SCOPE OF THE ENVIRONMENTAL ASSESSMENT

5.1.1 Identification of Valued Components

Based on its professional experience and work with similar projects, the Stantec team selected the following valued components (VCs) as those that should be considered as part of this EIA Registration:

- Atmospheric environment;
- Groundwater;
- Surface water;
- Fish and fish habitat;
- Vegetation and wetlands;
- Wildlife and wildlife habitat;
- Socioeconomic environment;
- Heritage resources; and
- Current use of land and resources for traditional purposes by Aboriginal persons.

In additon to the above VCs, effects of the environment on the project are also discussed. The following sections describe each of these VCs, their existing (baseline) conditions, potential interactions with the Project, and planned mitigation to reduce Project-environment interactions.

5.1.2 Spatial Boundaries

The assessment of potential environmental interactions with the VCs encompasses two spatial boundaries: the Project Development Area (PDA), which is common for all VCs, and a Local Assessment Area (LAA), which may vary from VC to VC.

5.1.2.1 Project Development Area

The PDA is the immediate area encompassing the Project footprint, and is limited to the anticipated area of physical disturbance associated with the construction, operation, and eventual closure of the Project. As described in Section 2.2, the PDA is divided into the footprint of components planned for Stage 1 and those planned for Stage 2, as shown in Figure 2.2. The Stage 1 PDA includes a TMF dam (including an emergency spillway), TMF basin, a polishing pond and dam, and water treatment facilities. The Stage 2 PDA includes an expanded TMF dam (with expanded emergency spillway), TMF basin, and an alternative access road to the Caribou site. The PDA also includes the locations of ancillary and temporary facilities required to support the Project (e.g., temporary laydown areas, access roads). The locations of the temporary facilities will be situated within the footprints of the TMF basin, or within areas previously disturbed as part of current mine operations. The Stage 1 PDA encompasses an area of approximately 43 ha, and the Stage 2 PDA encompasses the Stage 1 PDA plus an additional area of approximately 115 ha (for a total of 158 ha). The PDA is the same for all VCs.

5.1.2.2 Local Assessment Area

The LAA is defined as the maximum area where Project specific environmental interactions can be predicted and measured with a reasonable degree of accuracy and confidence (i.e., the zone of influence of the Project for each VC). The LAA can vary amongst the VCs, and is summarized for each VC in Table 5.1.

Table 5.1 Local Assessment Area for Valued Components

Valued Component	Local Assessment Area
Atmospheric environment (air, GHG)	From the edge of the PDA to 3 km in all directions
Atmospheric environment (noise)	From the edge of the PDA to 1 km in all directions
Groundwater	500 m from the edge of the PDA
Surface water	The PDA (Stage 2), and downstream of the proposed PDA extending down to the mouth of the Forty Mile Brook, at the confluence with the Nepisiguit River
Fish and fish habitat	From the headwaters of the north and south tributaries to Forty Mile Brook to the confluence of Forty Mile Brook and the Nepisiguit River. The LAA extends 30 m from the observed high water mark of the banks into the riparian area of watercourses. The LAA also includes the PDA.
Vegetation and wetlands	Within 500 m of the PDA
Wildlife and wildlife habitat	Within 500 m of the PDA
Socioeconomic environment	Not applicable (as per Section 5.2)
Heritage resources	PDA
Current use of land and resources for traditional purposes by Aboriginal persons	Not applicable (as per Section 5.2)

Table 5.1 Local Assessment Area for Valued Components

Valued Component	Local Assessment Area
Effects of the environment on the Project[1]	PDA
[1] Effects of the Environment on the Project is not a VC; however, it is included here for continuity in the assessment of potential interactions between the Project and the environment.	

5.1.3 Temporal Boundaries

Temporal boundaries identify when a potential environmental interaction is assessed in relation to specific Project phases and activities. The temporal boundaries for the assessment of the potential environmental interactions with the Project include the following periods:

- Construction
  - Construction of the Stage 1 NTTP dam is anticipated to begin in Q3-Q4 2020 and be commissioned in the winter of 2021.
- Operation
  - The Stage 1 NTTP dam is anticipated to provide tailings storage capacity beginning in 2021 and continue for the subsequent 3 years (until 2024) when the resource at Caribou mine is expected to be depleted. If it is ultimately decided to continue operating the mill as a toll-milling facility to process ores from other nearby satellite deposits in northern New Brunswick, the operation phase will continue until closure of the mill (with corresponding Stage 2 NTTP dam raise, regardless of whether or not the operation continues or ceases at the LoM).
- Closure/Post Closure
  - Construction and commissioning of the Stage 2 NTTP (raising of the Stage 1 NTTP dam) is expected to be completed by the end of 2025 or early 2026, allowing the underground components of the mine to be flooded for closure.
  - Ongoing operation (i.e., closure) of the Stage 2 NTTP is expected to occur in perpetuity, with water treatment occurring for at least 3 years or until water quality is seen to improve such that treatment can be discontinued.

Because construction and operation of the Stage 2 NTTP supports mine closure, this event will trigger an EIA registration prior to being completed. Although the construction and operation of the Stage 2 TMF is considered as part of this EIA registration, a more detailed assessment of effects of mine closure will be completed as part of a future EIA.

5.2 IDENTIFICATION OF POTENTIAL INTERACTIONS BETWEEN THE PROJECT AND THE ENVIRONMENT

Potential interactions between the Project and the various VCs of interest, by Project phase, are identified in Table 5.2. These potential interactions have been identified based on the nature of the Project, proposed mitigation, and anticipated environmental effects arising from Project activities based on current knowledge and professional judgement of the Study Team.

Table 5.2 Potential Interactions between the Project and the Environment

Activities/Physical Works Associated with the Project	Atmospheric Environment	Groundwater	Surface Water	Fish and Fish Habitat	Vegetation and Wetlands	Wildlife and Wildlife Habitat -	Socioeconomic Environment	Heritage Resources	Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons	Effects of the Environment on the Project
Construction	X	X	X	X	X	X	-	X	-	X
Operation	-	X	X	X	-	X	-	-	-	X
Closure/Post-Closure	X	X	X	X	X	X	-	X	-	X

Legend:
X Potential Interaction
- No interaction

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

VCs for which a potential interaction with the Project occurs are carried further in the environmental effects assessment in Sections 5.3 to 5.10. Some VCs were found to not have any potential interactions during one or any activity to be carried out as part of the Project. Further justification for not carrying these VCs or interactions forward is provided below.

Atmospheric Environment (Operation Phase Only)

No interaction has been identified for atmospheric environment during operation. Air and sound emissions from activities during operation are expected to be nominal, originating only from maintenance activities, and not likely distinguishable from current operation and maintenance activities at the site.

Heritage Resources (Operation Phase Only)

No interaction has been identified for heritage resources during operation as there is no planned ground disturbance during operation, so no potential for the discovery of buried heritage resources.

Socioeconomic Environment (All Phases)

The socioeconomic environment includes public and private use of land and resources, the economy, and public infrastructure, and services. Potential interactions between the Project and the socioeconomic environment 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 near a project.

The Project is located within an existing mining lease on private property held by TMNBL, except for the new polishing pond and the alternative access road to be constructed as part of the Project. The nearest owner-occupied residential and commercial property to the Caribou mine site is the Auberge Ressources Inn approximately 2.7 km away (linear distance) from the Caribou mine. Access to the mine property is restricted to mine personnel and it is not available for public use. Access to the PDA outside the existing property boundary will also become restricted as a result of the Project, however this footprint will be small relative to the available land in the surrounding area, and land and resource use is not limited in this area. While some recreational activity (e.g., hunting, fishing) is expected to take place generally in the area, the mine site itself is inaccessible to the public, and resources in the immediate vicinity of the proposed TMF are unlikely to be valued for recreational purposes due to impaired water quality immediately downstream of the mine site. Thus, no substantive change in the availability of land and resources for public use is anticipated as a result of the Project.

Construction of the Project is anticipated to be short-term, taking a year or less in both Stage 1 and Stage 2. The Project is expected to employ a small number of local people during construction relative to the total workforce at the mine, with some local expenditures for goods and services associated with construction, but in general the Project will not result in an appreciable increase in the existing workforce during construction or operation. The small and relatively short-term, temporary increase in employment will result in a positive economic effect; however, it does not represent a substantive change to the economy.

Given the small and short-term, temporary increase in employment, a substantive increase in use of public infrastructure and services is not anticipated as a result of the Project. Workers will likely commute from Bathurst or other nearby populated centres during construction. Existing public infrastructure and services such as police, fire, and medical facilities in these locations are anticipated to have sufficient capacity to accommodate any additional Project-related demand. During Stage 2, an alternative access road to the site will be required, and efforts will be made to use existing forestry road infrastructure. The location of the road will be better defined as engineering for Stage 2 progresses; however, given that the other nearby satellite ore deposits of interest to TMNBL are located to the west of the Caribou mine, it is anticipated that the new access road will likely shorten the distance trucks will need to travel between TMNBL satellite operations and the main mine site.

Given the remote location of the Project on private land with restricted access and the small, short-term, and temporary increase in employment and resulting demand for infrastructure and services, the Project is not anticipated to result in substantive changes to land and resource use, the economy, or infrastructure and services. It is not anticipated that there will be any likely interaction between the Project and the socioeconomic environment, and therefore no further assessment of this VC is warranted.

Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons (All Phases)

The assessment of current use of land and resources for traditional purposes by Aboriginal (Indigenous) persons ("Current Use") evaluates the environmental effects of the project on the inherent rights and ability of Indigenous persons to carry out traditional activities that use the land and resources as an integral part of their lives and culture. Often this use includes hunting, trapping, fishing, gathering, and following Indigenous customs, practices and traditions on these ancestral lands. The assessment of potential effects of a project on Current Use, in the case of a project such as that proposed at the Caribou mine, is typically limited to the physical footprint of the Project, the PDA, as the area that will be directly affected by Project activities, with a timeframe for Current Use often defined as the "living memory" of the Indigenous community or approximately the last 100 years. For the assessment of potential environmental effects on heritage resources that may be located within the PDA and Indigenous in origin, see the heritage resources VC (Section 5.9).

In order to assess potential environmental effects of a project on a Current Use VC, it needs to be determined that there is an interaction between the development footprint (the PDA) and activities of the Project and Current Use activities occurring within, or adjacent to, the PDA. Indigenous people have a constitutionally protected right to practice their traditional activities on Crown land, which for this Project will include land encompassed by the surface industrial lease for the STTP and portions of the PDA that extend outside of the TMNBL owned property. However, access to the mine property is controlled for safety concerns associated with it being an active industrial site, and has been since the mine's development, over 60 years ago. No unauthorized access is permitted within the property boundaries of the Caribou mine site, which includes access for hunting, gathering, or other traditional activities.

Exploration and mining operations began at the Caribou mine in 1954. Except for a small area associated with the new polishing pond (located outside TMNBL property but on Crown land), the PDA for this Project will be located mostly within the existing mining lease - in other words, the Project will be located within the area of restricted access. Traditional use of the surrounding area has also been influenced by the long-term mining operations, mainly through ARD runoff from early mining operations negatively affecting water quality of Forty Mile Brook downstream of the mine site. Because poor water quality has resulted in the decline of fish populations in Forty Mile Brook; it is not possible to fish in this watercourse and has not been for several decades. It is important to note that the Project is expected to improve water quality in the previously affected section of Forty Mile Brook, and as a result it is anticipated that fish habitat in this watercourse (below the polishing pond dam) will improve over time. Based on the Project description, it is not anticipated that there will be indirect effects to Current Use for lands adjacent to, or outside of the PDA.

TMNBL has an Indigenous representative serving in the role of Benefits Manager for Indigenous participation in the existing mine facility. This individual is also responsible for providing communication and information between the nine Mi'gmaq communities in New Brunswick and TMNBL. Within the Impact and Benefits Agreement TMNBL has with the nine Mi'gmaq First Nations, there is provision for Traditional Knowledge studies in respect of new developments at the mine, and TMNBL commits in that document to provide funding for such a study. Further, TMNBL has met with the Chiefs and Councils of Mi'gmaq First Nations in New Brunswick to discuss activities at the mine site. To date, no specific issues have been brought forward regarding Current Use activities that may be affected by the mining, the new TMF or related activities. TMNBL is planning further meetings with all the Mi'gmaq Chiefs regarding the Project and will be asking if additional information is needed, or if there is a desire for additional engagement in the communities about the Project.

Given the history of industrial use of the mine property, it is accepted that any use of Crown land by Indigenous persons for traditional purposes is taking place outside of the PDA. Forested Crown land is abundant in the area and there are no other industrial developments, beyond forestry operations, that will place restrictions on the First Nations' use of the surrounding Crown land for traditional purposes. It is expected that there is Current Use of the nearby Caribou Lake for fishing; however, this waterbody and any associated traditional use (e.g., fishing) will not be affected by the Project.

Outside of the TMNBL property, the Project is not anticipated to result in changes to any Indigenous person's ability to participate in traditional activities due to changes in the availability of resources (e.g., changes in fish species or plant or animal populations or the terrestrial environment or access to land), and therefore it is not anticipated that there will be a likely interaction between the Project and current use of land and resources for traditional purposes by Indigenous persons, and therefore no further assessment of this VC is warranted.

TMNBL is committed to continuing engagement of, and dialogue with, Indigenous people and communities that may have an interest in the Project by providing information about the Project and the Project activities. Should an interaction be identified, the information will be provided, with the permission of the Indigenous community, to NBDELG for consideration and the development of appropriate mitigation in discussion with the affected Indigenous persons and/or communities and regulatory agencies as warranted.

5.3 ASSESSMENT OF POTENTIAL INTERACTIONS WITH THE ATMOSPHERIC ENVIRONMENT

This section assesses the potential interactions between the Project and the atmospheric environment.

5.3.1 Scope of Assessment

The atmospheric environment VC includes consideration of potential environmental effects on air quality, greenhouse gases, and sound quality. These components constitute a VC due to:

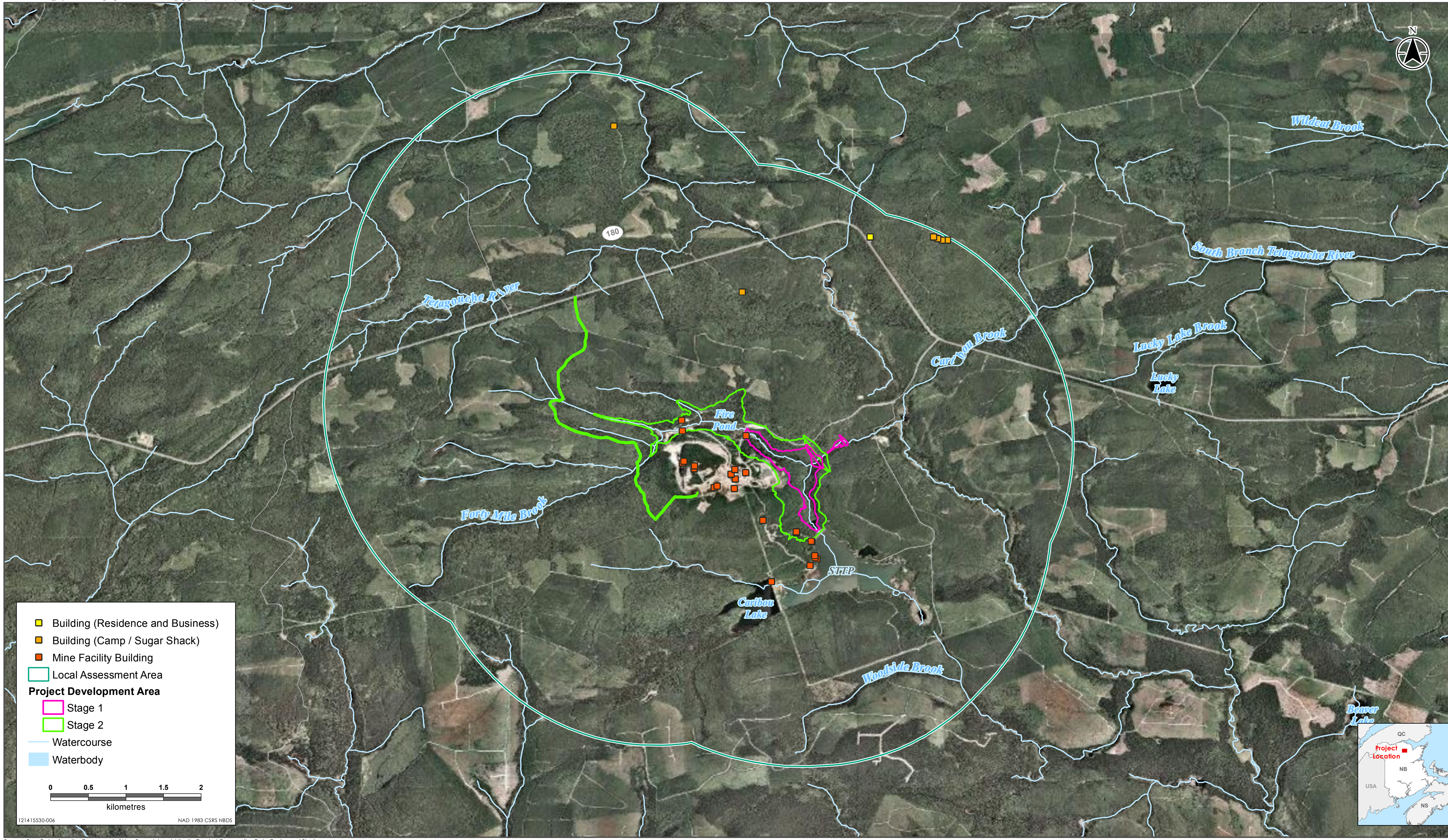
- Emissions to the atmosphere from the Project which may present a pathway for humans and biota to be exposed to air contaminants;
- Provisions regarding air contaminant and noise emissions under the New Brunswick *Clean Air Act* and *Air Quality Regulation*;
- Releases of GHGs and their accumulation in the atmosphere influence global climate and may affect current or soon to be developed GHG emission reduction targets (federal and provincial); and
- Project noise and the potential related environmental effects on community health, with guidelines provided by Health Canada.

Further, the atmosphere functions as a pathway for the transport of air contaminants and sound to the freshwater, marine, terrestrial, and human environments.

The PDA is defined in Section 2.1 and is unchanged for the purposes of this assessment.

The LAA for each VC is the maximum area within which environmental effects from the Project activities and components can be predicted or measured with as reasonable degree of accuracy and confidence. For considering a potential change in air quality and a change in GHG emissions, the LAA generally extends from the edge of the PDA to 3 km in all directions. For considering a potential change in acoustic environment, the LAA generally extends from the edge of the PDA to 1 km in all directions. At a distance of 1 km from Project-related sources of sound emissions (heavy equipment, trucks), there is sufficient distance for the sound to naturally attenuate such that it will be (for the most part) not detectable over background sound pressure levels.

The PDA and LAA for atmospheric environment are shown in Figure 5.1.



Sources: Base Data - from the Government of New Brunswick and Atlantic Candad Conservation Data Centre, and Stantec.
Service Layer Credits: Service New Brunswick/Service Nouveau Brunswick

Local Assessment Area for the Atmospheric Environment

Stantec

121415530 - TREVALI MINING (NEW BRUNSWICK) LTD.

Figure 5,1

5.3.2 Existing Conditions for Atmospheric Environment

The atmospheric environment is described in the context of air quality, greenhouse gases, and sound quality.

5.3.2.1 Air Quality

Key information for existing air quality included data provided by the most recently published New Brunswick Air Quality Monitoring Results Report for the year 2015 (NBDELG 2017), the most recent year available at the time of writing. The report summarizes data obtained from the air quality monitoring network that has been operated by the Provincial government and industry in New Brunswick to monitor ambient concentrations of various air contaminants in selected New Brunswick communities. The monitoring network was designed by NBDELG primarily to monitor compliance with ambient air quality objectives, and standards.

Ambient Air Quality

The NBDELG operated air quality monitoring station that is located closest to the PDA is located in Bathurst, located approximately 50 km east of the Project. Ground-level ozone (O_3), nitrogen dioxide (N_2O) and particulate matter less than 2.5 microns ($PM_{2.5}$) are measured at the Bathurst station. There have been no exceedances of the New Brunswick Air Quality Objectives under the *Clean Air Act* at the Bathurst station in 2012, 2013, 2014 or 2015 for ozone, nitrogen dioxide, or $PM_{2.5}$ (NBDELG 2017).

Existing Air Contaminant Emissions

The existing air contaminant emissions in New Brunswick, presented below, are based on data reported to the National Pollutant Release Inventory (NPRI) for 2016 (ECCC 2017c). This was the most recent year of quality-assured, published data at the time of conducting the assessment. The NPRI requires industrial facilities to report specific air contaminant emissions to Environment and Climate Change Canada when facility reporting thresholds are met. The closest reporting industrial facilities to the PDA are the existing Caribou Mine, the Glencore Canada Corporation Brunswick Mine (approximately 45 km southeast of the Project, now closed), and Fornebu Lumber Co. – Bathurst Lumber (approximately 55 km east of the Project). A number of industrial facilities also exist in Belledune, approximately 50 km northeast of the Project, including the NB Power Belledune Generating Station and the Glencore Canada Corporation Belledune Smelter.

In 2016, 65 New Brunswick facilities reported criteria air contaminant emissions to the NPRI. Table 5.3 provides a summary of provincial and national air contaminant emissions as reported to the NPRI for the 2016 calendar year.

Table 5.3 Comparison of Provincial and National Air Contaminant Emissions (2016)

Value	Combustion Gases			Particulate Matter	
	Sulphur Dioxide (SO2)	Nitrogen Oxides as Nitrogen Dioxide (NOx as NO2)	Carbon Monoxide (CO)	PM total	PM2.5
Provincial (NB) Total Reported (tonnes), 2016	20,010	14,142	30,130	4,202	1,179
National Total Reported (tonnes), 2016	976,395	588,177	869,482	329,636	48,336
Provincial Percent of National Total (%), 2016	2.05%	2.40%	3.47%	1.28%	2.44%
Source: 2016 NPRI (ECCC 2017c)					

New Brunswick's contribution to the national total releases of air contaminants is relatively low, approximately 1.21 to 3.46% of the national totals, on average. There is relatively good air quality experienced in New Brunswick most of the time. This is evidenced by the observed low frequency of exceedance of Canadian Ambient Air Quality Standards (2014; 2016) and the New Brunswick Air Quality Objectives (NBDELG 2015) and the relatively few industrial air contaminant emissions sources.

5.3.2.2 Greenhouse Gas Emissions

A literature review was performed to establish the current level of GHG emissions from sources in New Brunswick, Canada, and globally. ECCC collects GHG emissions information and other relevant data across Canada annually and produces an annual National Inventory Report as part of its commitments under the United Nations Framework Convention on Climate Change (UNFCCC). The latest National Inventory Report is for the reporting year 2015 (ECCC 2017b). A comparison of provincial and national GHG emissions for 2015 is presented in Table 5.4.

The World Resources Institute's Climate Analysis Indicators Tool provides a comprehensive database for global GHG emissions data of all major sources and sinks. The latest year for GHG emissions on the database was 2014 (WRI 2015).

Table 5.4 Comparison of Provincial and National GHG Emissions (2015)

Value	Carbon Dioxide (CO_2)	Methane (CH_4 as CO_2e)	Nitrous Oxide (N_2O as CO_2e)	Other GHGs (as CO_2e)	Total GHG Emissions (as CO_2e)
Provincial Total Reported (kilotonnes CO_2e), 2015	12,400	1,100	400	231	14,100
National Total Reported (kilotonnes CO_2e), 2015	568,000	102,000	39,000	12,390	722,000
Provincial Percent of National Total (%), 2015	2.2%	1.1%	1.0%	1.9%	1.9%
Note: Source: ECCC (2017b). Totals for National do not add up in ECCC (2017b) due to rounding.					

New Brunswick contributes approximately 1.9% of Canada's GHG emissions.

The estimated carbon dioxide equivalent emissions globally were approximately 36 billion tonnes CO_2e in 2014 (including land use change and forestry) (WRI 2015). Canada's contribution to global GHG emissions is approximately 1.8%.

5.3.2.3 Sound Quality

Sound quality in the PDA is typically influenced by sounds from the operation of the existing facility. No baseline data were collected as the contribution from the Project to sound quality is expected to be limited to construction activities (i.e., temporary and short in duration) and there are no nearby residents to be considered during construction. Based on the remote location of the Caribou mine, sound levels approximately 1 km from the mine will be expected to be typical of those experienced in a forested rural environment and are likely less than 50 dBA. Conclusions of this assessment were based on experience and professional judgment of the study team.

5.3.3 Potential Project Interactions with Atmospheric Environment

5.3.3.1 Air Quality

Air contaminants will be released principally from construction and closure activities. Emissions from activities during operation are expected to be nominal, originating only from maintenance activities.

Emissions were estimated for key Project activities during construction that may cause air contaminants to be released to the atmosphere. These include:

- Dust from topsoil and overburden removal;
- Dust from handling operations (e.g., loading and dumping) of topsoil, rock, and overburden;
- Dust from equipment movements on unpaved (construction) roads; and
- Diesel combustion in construction (e.g., loaders, dump trucks).

Diesel combustion air contaminant emissions estimates from construction equipment are based on assumed equipment working hours, typical equipment characteristics including horsepower and load factor, and CAC emission factors from the US EPA NONROAD program (US EPA 2008). The horsepower, load, operating hours, and equipment-specific emission factors were multiplied to yield the CAC emissions for each piece of equipment.

The equipment, horsepower, and operating hours of the heavy construction equipment to be used during construction (Stage 1) and closure (Stage 2) are identified in Table 5.5.. The total emissions of air contaminants during the construction (Stage 1) and closure (Stage 2) were estimated and are shown in Table 5.5..

Table 5.5 Construction Equipment Characteristics and Air Contaminant Emissions – Stage 1 (Construction) and Stage 2 (Closure)

Equipment Type (No.)	Net horsepower (hp)	Operating Hours (h)	Air Contaminant Emissions for Construction Period – 6 months for each Stage (t)			
			SO_2	NO_X	CO	PM
Stage 1 (Construction)						
Cat D8T crawler tractor (3)	312	5,184	0.003	0.268	0.126	0.009
Cat 745 Articulated Truck (20)	417	34,560	0.037	2.923	1.384	0.102
Cat 352F excavator (5)	174	8,640	0.008	0.596	0.280	0.020
Cat Compactor CS78B (3)	373	5,184	0.002	0.149	0.060	0.005
Cat 986K Loader (2)	511	3,456	0.003	0.213	0.085	0.007
Sandvick Mobile Crusher UJ440i (1)	1,728	1,728	0.001	0.088	0.022	0.003
Ponssee Ergo - Tree Harvester (2)	286	720	0.000	0.034	0.014	0.001
Ponssee Buffalo – Porter (1)	286	720	0.000	0.034	0.014	0.001
Haul Truck (3)	350	720	0.001	0.042	0.017	0.001
Stage 1 – Total (6 months)			0.055	4.347	2.001	0.151
Stage 2 (Closure)						
D8T crawler tractor (3)	312	5,184	0.003	0.268	0.126	0.009
745 Articulated Truck (20)	417	34,560	0.037	2.923	1.384	0.102
352F excavator (5)	174	8,640	0.008	0.596	0.280	0.020
Cat Compactor CS78B (3)	373	5,184	0.002	0.149	0.060	0.005
Cat 986K Loader (2)	511	3,456	0.003	0.213	0.085	0.007
Sandvick Mobile Crusher UJ440i (1)	1,728	1,728	0.001	0.088	0.022	0.003
Ponssee Ergo - Tree Harvester (2)	286	2,880	0.002	0.136	0.054	0.005
Ponssee Buffalo – Porter (1)	286	2,880	0.002	0.136	0.054	0.005
Haul Truck (3)	350	2,880	0.002	0.167	0.066	0.006
Stage 2 – Total (6 months)			0.059	4.677	2.132	0.162
TOTAL Project (Stage 1+Stage 2, 12 months)			**0.114**	**9.025**	**4.133**	**0.314**
SOURCE: US EPA (2008); Caterpillar (2012).						

Emissions of sulphur dioxide from Project construction for Stage 1 are estimated at 0.055 tonnes; total emissions of nitrogen oxides, carbon monoxide, and total particulate matter from Project construction for both stages are estimated at 4.347 tonnes, 2.001 tonnes, and 0.151 tonnes, respectively, spread over the construction period (6 months). Emissions during closure (Stage 2) are marginally (6.5% to 7.6%) higher than for Stage 1 construction, also expected to occur over a 6-month construction period.

These construction and closure emissions are low in magnitude relative to other similar projects in the mining sector. During the construction and closure periods, these emissions are not likely to cause poor air quality in Restigouche County, as they are low in magnitude and mitigation will be used to control emissions to maintain good air quality near the Project.

Emissions during operation are expected to be very low, and not perceptible.

Mitigation

Throughout construction, operation, and closure, TMNBL will control CAC emissions from Project activities by implementing the following mitigation measures:

- Manage vehicle and equipment emissions by conducting regular maintenance on all machinery and equipment;
- Control construction-related fugitive road dust, through measures such as speed limits on Project-controlled gravel roads and road watering on an as-needed basis;
- Prohibit the burning of waste materials; and
- Reduce haul distances to disposal sites.

TMNBL is committed to continuous improvement and will continue to evaluate opportunities to reduce emissions throughout construction, operation, and closure.

5.3.3.2 Greenhouse Gas Emissions

GHGs are released into the atmosphere principally from the combustion of fossil fuels. Other GHG sources, such as fugitive releases, are not likely to occur and are therefore not relevant to the assessment.

Emissions of GHGs (CO_2, CH_4, and N_2O) from diesel combustion in construction equipment for Stages 1 and 2 of the Project were estimated considering approximate equipment working hours, fuel consumption rate, and GHG emission factors from the National Inventory Report (ECCC 2017b). The equipment working hours were used with the fuel consumption rate to determine the total volume of diesel combusted. Volume-based diesel combustion factors were then applied to estimate emissions of CO_2, CH_4, and N_2O.

The carbon dioxide equivalent, or CO_2e, is determined by measuring the GHG emissions weighted by its associated global warming potential (GWP) for each gas, relative to CO_2. The GWP for a gas is used to compare its global warming impact with another gas (US EPA 2017). The GWP compares how much heat will be trapped in the atmosphere compared to a similar mass of CO_2 (as a reference gas). Therefore, the higher the GWP, the more warming to the atmosphere could result from that gas.

The CO_2e (t CO_2e) calculation from CO_2, CH_4, and N_2O emissions is as follows:

$$CO_2e = CO_2 \times GWPCO_2 + CH_4 \times GWPCH_4 + N_2O \times GWPN_2O$$

The equipment, operating hours, and fuel rates of the heavy construction equipment to be used during construction of Stages 1 and 2 are identified in Table 5.6. The equipment hourly fuel rates are based on manufacturer specifications and the operating hours are estimated based on the construction activities.

Table 5.6 Construction Equipment Characteristics and GHG Emissions – Stage 1 (Construction) and Stage 2 (Closure)

Equipment Type (No.)	Litres of diesel/h	Operating Hours (h)	Total Fuel (L)	Total Emissions (t) – 6 months per Stage			
				CO_2	CH_4	N_2O	CO_2e
Stage 1 (Construction)							
D8T crawler tractor (3)	625	5,184	270,151	726.7	0.04	0.27	808.2
745 Articulated Truck (20)	550	34,560	1,582,704	4,257.5	0.24	1.58	4,735.1
352F excavator (5)	720	8,640	518,472	1,394.7	0.08	0.52	1,551.1
Cat Compactor CS78B (3)	334	5,184	144,081	387.6	0.02	0.14	431.1
Cat 986K Loader (2)	534	3,456	153,904	414.0	0.02	0.15	460.4
Sandvick Mobile Crusher UJ440i (1)	569	1,728	81,864	220.2	0.01	0.08	244.9
Ponssee Ergo - Tree Harvester (2)	250	720	7,500	20.18	0.00	0.01	22.44
Ponssee Buffalo – Porter (1)	200	720	6,000	16.14	0.00	0.01	17.95
Haul Truck (3)	133	720	4,000	10.76	0.00	0.00	12.97
Stage 1 – Total (6 months)				7,447.74	0.42	2.77	8,283.2
Stage 2 (Closure)							
D8T crawler tractor (3)	625	5,184	270,151	726.71	0.04	0.27	808.22
745 Articulated Truck (20)	550	34,560	1,582,704	4,257.47	0.24	1.58	4,735.05
352F excavator (5)	720	8,640	518,472	1,394.69	0.08	0.52	1,551.14
Cat Compactor CS78B (3)	334	5,184	144,081	387.58	0.02	0.14	431.05
Cat 986K Loader (2)	534	3,456	153,904	414.00	0.02	0.15	460.44
Sandvick Mobile Crusher UJ440i (1)	569	1,728	81,864	220.21	0.01	0.08	244.92
Ponssee Ergo - Tree Harvester (2)	250	2,880	30,000	80.70	0.00	0.03	89.75
Ponssee Buffalo – Porter (1)	200	2,880	24,000	64.56	0.00	0.02	71.80
Haul Truck (3)	133	2,880	16,000	43.04	0.00	0.02	47.87
Stage 2 – Total (6 months)				7,588.96	5.40	2.82	8,440.25
TOTAL Project (Stage 1+Stage 2, 12 months)				**15,037**	**0.84**	**5.59**	**16,723**
SOURCE: US EPA (2008), Caterpillar (2012).							

The volume of fuel and the WCI emission factors (2012) were used to estimate emissions for each gas (CO_2, CH_4, N_2O).

The total direct GHG emissions from Stage 1 construction activities are estimated to be approximately 8,283 tCO_2e spread over the 6-month construction period. The total GHG emissions from Stage 2 construction activities (closure) are estimated to be approximately 8,440 tCO_2e spread over the 6-month construction period. Thus, the total direct GHG emissions resulting from the Project (i.e., from both Stage 1 construction and Stage 2 closure) is estimated at 16,723 tCO_2e over the 12-month cumulative period.

In addition to direct emissions from construction activities for the Project, the Project will result in the loss of carbon sinks as the vegetation that currently exists where the TMF will be located is removed to make way for the Project. The forested area occupied by the Project and related GHGs were assessed. Based on the Forest Inventory, Region A.3 (Gray 1995), which includes New Brunswick, tree species are approximately 50% coniferous (i.e., spruce, pine, fir), with the remainder composed of broad-leaved species (e.g., maple, beech, birch) and other unclassified species. For this assessment, it is assumed that coniferous and broad-leaved species in the area of the Project have a 50:50 ratio. The increases in carbon storage with age for both coniferous and broad-leaved trees species are shown in Figures 5.2 and 5.3, respectively (US EIA 2000).

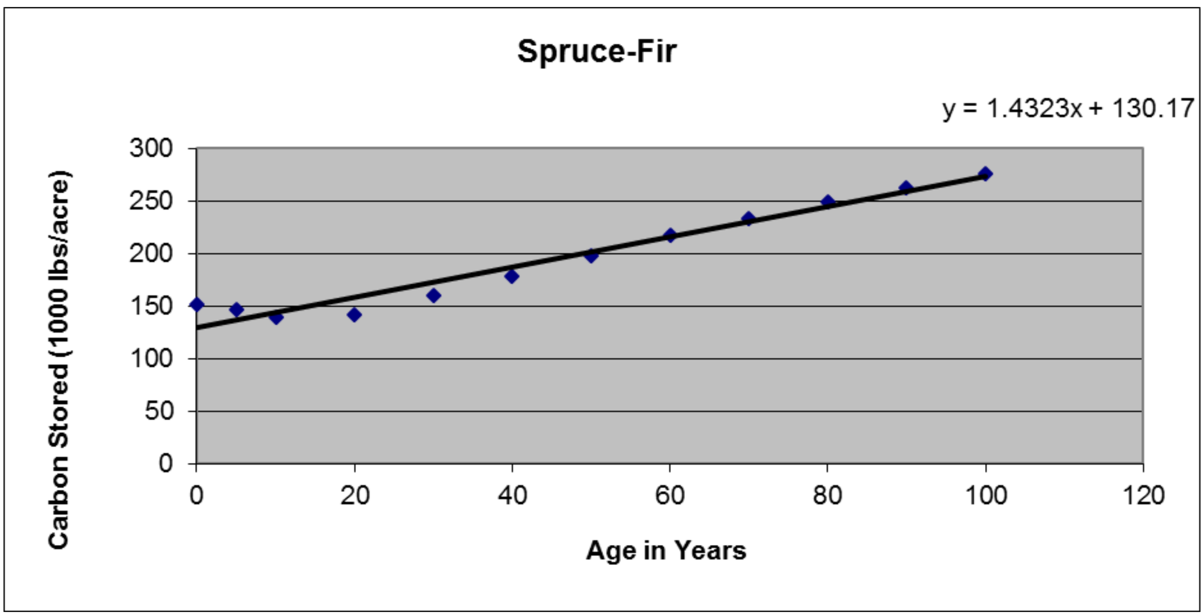


Figure 5.2 Carbon Storage for Coniferous Tree Species

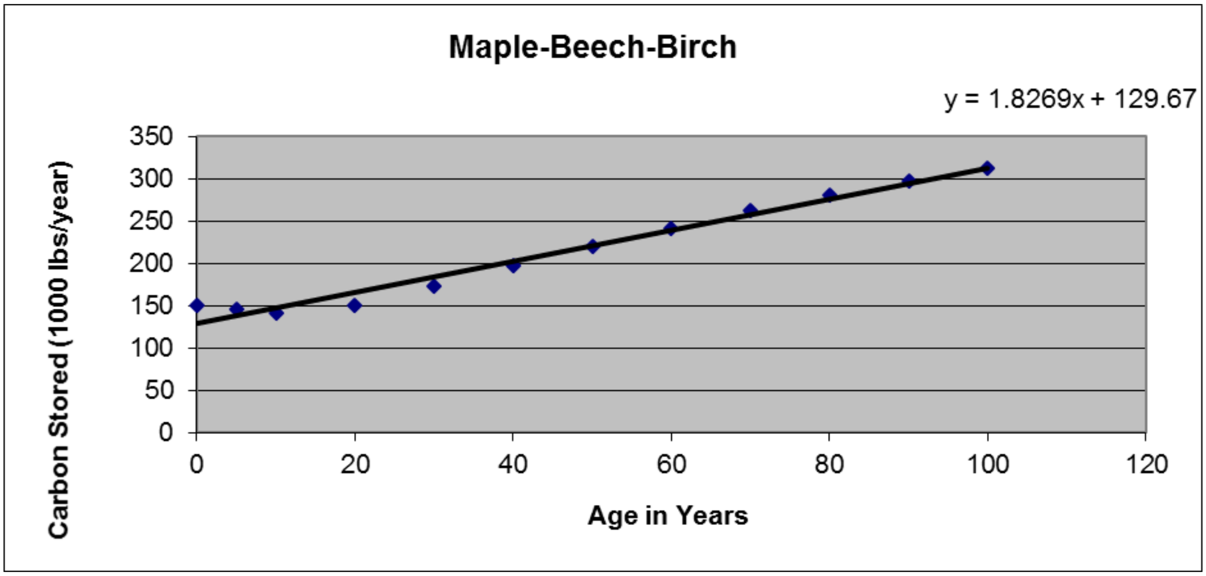


Figure 5.3 Carbon Storage for Broad-Leaved Tree Species

Based on this information, coniferous species have an average rate of carbon storage of 1,430 lb carbon/acre/year (or 5,248 lb CO_2/acre/year). Further, broad-leaved species have an average rate of carbon storage of 1,830 lb carbon/acre/year (or 6,716 lb CO_2/acre/year).

Based on land use data provided in Section 5.7.2.3 of tree cover area in the PDA, 69.1 acres of forest and treed swamp will be lost during Stage 1 construction and 193.8 acres of forest and treed swamp will be lost during Stage 2 construction. The estimated change in CO_2 associated with this loss is provided in Table 5.7.

Table 5.7 Estimated Change in CO_2 Storage Capacity Arising from Tree Clearing

Stage	**Forest** and Treed Swamp Area	**CO_2** stored (coniferous)	**CO_2** stored (broad-leaved)	**Total Potential** CO_2 stored	**Total Potential** CO_2 stored
	(acres)	**lb/acre/year**	**lb/acre/year**	**lb/year**	**tonnes/year**
Stage 1	69.1	5,248.0	6,716.0	413,447.5	187.5
Stage 2	193.8	5,248.0	6,716.0	1,159,338.2	525.9
Total	262.9	10,496.0	13,432.0	1,572,785.8	713.4

It is estimated that there will be an average loss of 713.4 tonnes CO_2/year of carbon storage due to the 262.9 acres of forest and treed swamp area affected by the Project.

Based on the above, the residual environmental effects of the Project during construction are predicted to be adverse, since there is an increase in GHG emissions. The magnitude is less than 10,000 t CO_2e/year and therefore the emissions are estimated to be low, based on the characterizations of “low”, “moderate”, and “high” identified in the document entitled “Incorporating Climate Change Considerations in Environmental Assessment: General Guidance for Practitioners” published by the Canadian Environmental Assessment Agency (CEA Agency 2003). These environmental effects are expected to be similar during the operation and closure phases, though likely less than during construction.

Direct emissions of GHGs during operation are expected to be similar to baseline conditions, and emissions during closure are expected to be less than construction, and therefore were not quantified. In addition, during operation, there may be short-term GHG (methane) emissions from the decomposition of residual organic matter contained in the area of the TMF (i.e., limbs, ground vegetation, and other residual biomass that remains after trees have been harvested), but since the mature trees will be harvested prior to flooding, these emissions are not expected to be substantive.

Mitigation

Emissions of GHGs during construction will be reduced to the extent practical by:

- Minimizing the footprint of the TMF to limit the extent of disturbance;
- Using construction equipment that is well maintained;
- Implementing an idling awareness program to reduce unnecessary idling; and
- Reducing haul distances to disposal sites.

5.3.3.3 Sound Quality

Health Canada has produced the document "Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise" (Health Canada 2016), which provides guidance on sound levels at the most exposed façade of a noise sensitive receptor for both construction and operation of sound emission sources. The recommended assessment method for long-term construction (greater than one year), as well as operational noise, is to establish the baseline, construction, and operation day-night sound pressure levels (L_{DN}) and the percent of the population that is highly annoyed (% HA) by the increase in sound pressure levels. Sensitive receptors are residences, churches, nursing homes, schools, daycares, and hospitals.

Sound levels due to construction activities were not quantitatively assessed, as baseline monitoring was not conducted for this assessment. A qualitative assessment, based on Project activities during construction, operation, and closure, and distances from nearby receptors, is provided in this section.

During construction, sound emissions will result from the operation of heavy equipment (for excavating and vegetation clearing) and from transportation vehicles on Project access roads. Noise will, however, remain largely confined to the PDA and the immediately adjacent areas, and will be temporary. There are no nearby noise sensitive receptors (Figure 5.1), given the remote location of the mine site; therefore, noise disturbance and annoyance is not expected to be a concern for this Project.

Due to the intermittent nature of the construction activities (i.e., not continuous over the construction period) and based on the professional judgment and experience of the study team with similar projects, the change in %HA during construction is expected to be less than 6.5%.

The operation activities will result in sound emissions, predominantly from heavy equipment during maintenance and other routine activities. Sound emissions from operation, however, are anticipated to be similar to baseline conditions, as operation activities at the site are not expected to change. Sound emissions during closure are expected to be similar or less than those that will occur during construction.

The change in %HA during operation are expected to be less than 6.5%, as there are no elements of the Project that will generate sound emissions (i.e., the TMF operates passively) and the remainder of the mine site is expected to operate similarly to existing conditions. Project-related effects on sound quality are therefore not expected to be substantive. Sound emissions during closure are expected to be similar to those that will occur during construction.

Based on the reasons above, and the implementation of known and proven mitigation, the noise levels are expected to be low and not frequently exceed the noise guidelines. Therefore, Project-related effects on sound quality are not expected to be substantive.

Mitigation

The following mitigation for sound during construction and closure will be considered and implemented, as needed:

- Using well-maintained construction equipment with appropriate mufflers;
- Using acoustical barriers (e.g., engineered materials or stockpiled overburden) near loud sources during construction if feasible;
- Sizing construction equipment to the smallest needed to perform the work; and
- Working mostly during daytime hours.

5.3.4 Summary for Atmospheric Environment

Air contaminants and GHGs will be released principally from construction activities (Stage 1) and closure activity (Stage 2 construction). These emissions are estimated to be low and mitigation will be used to control emissions to maintain good air quality near the Project.

During construction, sound emissions will result from operation of heavy equipment and transportation vehicles on Project access roads. There are no nearby sensitive receptors and therefore noise disturbance is not a concern during the construction of this Project.

During operation, air quality, GHGs, and sound quality are expected to be similar to baseline conditions, as operation at the site is not anticipated to change.

The dismantling and removal/disposal of associated TMF surface infrastructures (pumphouse, roads, pipelines, etc.) will not be assessed as part of this study and will be further assessed during the mine closure stage as part of the permitting and EIA approval process required at that time.

Based on the limited interactions noted above, and the planned implementation of known and proven mitigation, no substantive interactions between the Project and the atmospheric environment are anticipated.

5.4 ASSESSMENT OF POTENTIAL INTERACTIONS WITH GROUNDWATER

This section assesses the potential environmental interactions between the Project and groundwater.

5.4.1 Scope of Assessment

Groundwater includes domestic, commercial, and industrial groundwater-source water supplies, and the groundwater component of freshwater systems. Groundwater was included as a VC because it is a potential source of potable water for residential, industrial, and/or commercial uses, and is important in maintaining ecological habitats by supporting stream flow, vegetation, and wetlands. Groundwater is an integral component of the hydrologic cycle, is an important source of potable water for human use and is a pathway to surface water and vegetation communities.

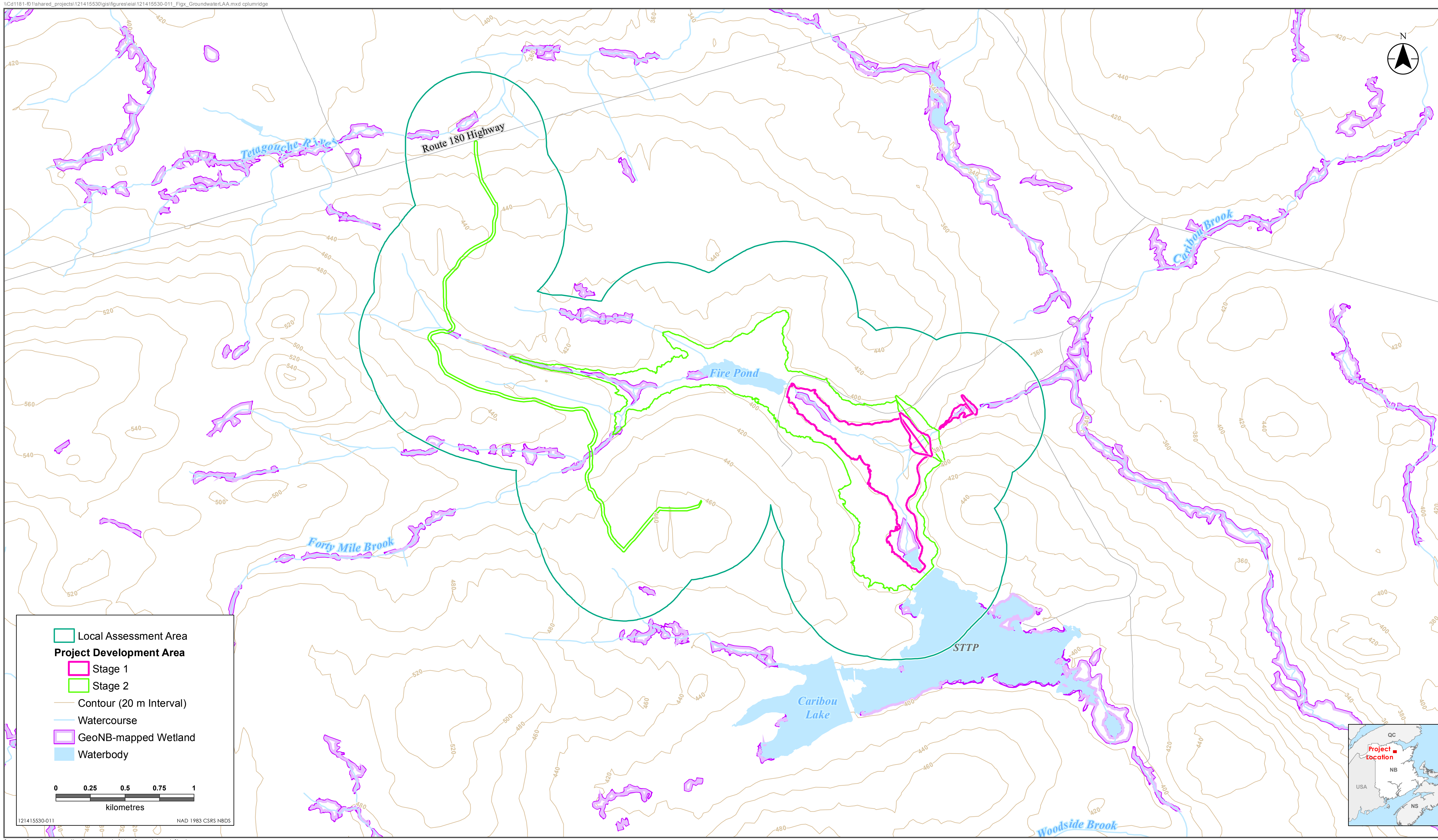
The Province of New Brunswick has legislation in place to manage and protect water resources (both surface water and groundwater), including the *Clean Water Act* and the *Clean Environment Act*. Specific regulations under the *Clean Water Act* that relate to the protection of groundwater include the *Wellfield Protected Areas Designation Order*, the *Water Well Regulation*, and the *Potable Water Regulation*.

The *Wellfield Protected Areas Designation Order* defines areas around production wells used for public water supply systems. The Designation Order restricts the types of activities that can be carried out within the Wellfield Protected Area, thereby reducing the risk of contaminants (i.e., bacteria and viruses, petroleum products and chlorinated solvents) reaching the wells.

The *Water Well Regulation* defines how water wells are to be constructed in New Brunswick so that water quality is not compromised by local runoff or land use activities. The *Potable Water Regulation* requires water quality testing for all new water wells installed in the province, and for regulated water supply systems. The *Water Well Regulation* is applicable to all water wells in the area of review, including potential future water wells.

Although groundwater resources in Canada are generally managed by provincial regulatory bodies as described above, the Guidelines for Canadian Drinking Water Quality (GCDWQ) published by Health Canada are also applicable to groundwater across Canada; however, they have no force of law unless adopted through a regulatory instrument. The GCDWQ are "*established based on current published scientific research related to health effects, aesthetic effects and operational considerations*" (Health Canada 2017).

The local assessment area (LAA) for groundwater is defined as the potential zone of Project interactions with groundwater resources. Specifically, the LAA is considered the maximum spatial area within which environmental effects from the Project activities can be predicted or measured with a reasonable degree of accuracy and confidence. The LAA for groundwater is assumed to extend 500 m from the PDA (Figure 5.4).



Sources: Base Data - from the Government of New Brunswick and Stantec.
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Local Assessment Area for Groundwater

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Figure 5.4

5.4.2 Existing Conditions for Groundwater

5.4.2.1 Approach and Methods

A combination of spatial analysis and baseline research was used to characterize groundwater in the LAA. Baseline research included a review of online sources for groundwater information, including:

- Water quality data collected as part of ongoing quarterly groundwater sampling at the Caribou mine;
- Water level data collected from monitoring wells at the Caribou mine;
- GIS databases, published maps, and aerial photography;
- The New Brunswick Online Well Log System (known as NBOWLS; NBDELG 2018b);
- Geological mapping from the New Brunswick Department of Energy and Resource Development (NBDERD); (formerly known as the New Brunswick Department of Energy and Mines); and
- Reports from previous groundwater, hydrology, and geotechnical investigations at the Caribou mine.

5.4.2.2 Description of Existing Conditions

Geology

Regionally, the bedrock geology is mapped as consisting of the mafic and felsic volcanic rock of the California Lake Group in the northwestern portions of the LAA, and felsic volcanic rock of the Tetagouche Group in southern portions of the LAA. Both of these groups are of Middle Ordovician age and consist of metamorphosed volcanic and sedimentary rocks. The Caribou ore body is situated in a massive sulphide deposit, and has the potential to generate ARD if exposed to oxygen-rich water, which could interact with local groundwater resources.

The surficial geology within the LAA consists of exposed bedrock in the northern portion of the LAA, and mainly stoney till morainal sediments in the southern portion of the LAA in the vicinity of the STTP (Rampton 1984).

Groundwater Resources

No designated Wellfield Protected Areas exist within the PDA or LAA. A query of the NBOWLS (NBDELG 2018b) indicates that there are no known water wells located within the LAA. However, as the NBOWLS only contains water well records for wells drilled since 1994, some additional wells may exist. The closest known water wells are located approximately 3 km north northeast of the PDA and approximately 3.5 km west of the PDA. The well yields, depths to water table, overburden thickness and well depths are listed in Table 5.8.

Table 5.8 Water Well Details from NBOWLS

Report Number	Well Use	Total Depth (m below ground surface (bgs))	Driller's Yield (L/min)	Depth to Water (m bgs)	Depth to Bedrock (m bgs)
21525	Domestic	24.38	114	4.57	0
21677	Domestic	18.29	14	4.57	0
21689	Domestic	42.67	1	4.57	0.61
Notes: n/a = Information not available					

The well yields listed on Table 5.8 are between 1 and 114 L/min. The depth to bedrock reported for the wells on Table 5.8 is consistent with the expected overburden thicknesses from the regional geological maps, which indicate exposed bedrock through these areas (Rampton 1984). Groundwater quality data for these wells are not available, as there are too few wells in the area to extract this information from NBOWLS or the Groundwater Chemistry Atlas (NBENV 2008).

Groundwater at Caribou Mine

Groundwater flow patterns at the Caribou mine are anticipated to generally mimic the topography, with flow radially from the middle of the site. However, active dewatering of the underground workings is expected to result in local groundwater flow towards the underground workings.

Limited hydrogeological testing was conducted at Caribou mine (SRK 2014). This includes some limited hydraulic conductivity testing of the native till and bedrock, and the historical Anaconda tailings (Golder 2000, Stantec 2015c). The hydraulic conductivity of these materials is summarized in Table 5.9. Based on these results, the shallow weathered bedrock is expected to have a relatively high hydraulic conductivity, about two orders of magnitude higher than the overlying till (where present). Therefore, groundwater in the LAA is expected to flow preferentially through the shallow bedrock.

Table 5.9 Hydraulic Conductivity of Materials at Caribou Mine

Tested Well ID	Screened Interval (m bgs)	Material	Hydraulic Conductivity (m/s)
BH00-1A	13.9-14.6	Till	3.4×10^{-7}
BH00-2	3.1-4.5	Bedrock	1.2×10^{-4}
BH00-6A	3.2-4.0	Till	5.5×10^{-7}
BH00-6B	1.7-2.4	Anaconda Tailings	1.0×10^{-5}
BH-04	7.6-13.7	Bedrock	3.0×10^{-6}
BH-04B	4.0-5.5	Bedrock	3.3×10^{-6}
BH-05	20.1-23.1	Bedrock	2.3×10^{-6}
BH-06	18.3-21.3	Bedrock	5.4×10^{-6}
BH-07	18.7-21.7	Bedrock	1.5×10^{-5}
BH-08	16.5-19.5	Bedrock	8.2×10^{-7}
BH-10	21.3-24.4	Bedrock	5.3×10^{-5}

Groundwater Quality

Historical mining activities at the Caribou mine have resulted in the exposure of potentially acid-generating waste rock and tailings to oxidizing conditions that have resulted in ARD. This has resulted in the degradation of water quality in groundwater downgradient of the historical waste rock disposal area south of Fire Pond, the mine workings, and the Anaconda tailings. Bi-annual groundwater quality monitoring has been carried out by TMNBL in six monitoring wells within the LAA since late 2012. The locations of these monitoring wells are shown on Figure 5.5. This includes three wells near the mine workings (CMW-1, CMW-2, and CMW-3), two wells in and around the historical waste rock dump (CMW-4 and CMW-5), and one well downgradient of the historical Anaconda tailings CMW-6). The average groundwater quality for a suite of parameters are presented in Table 5.10.

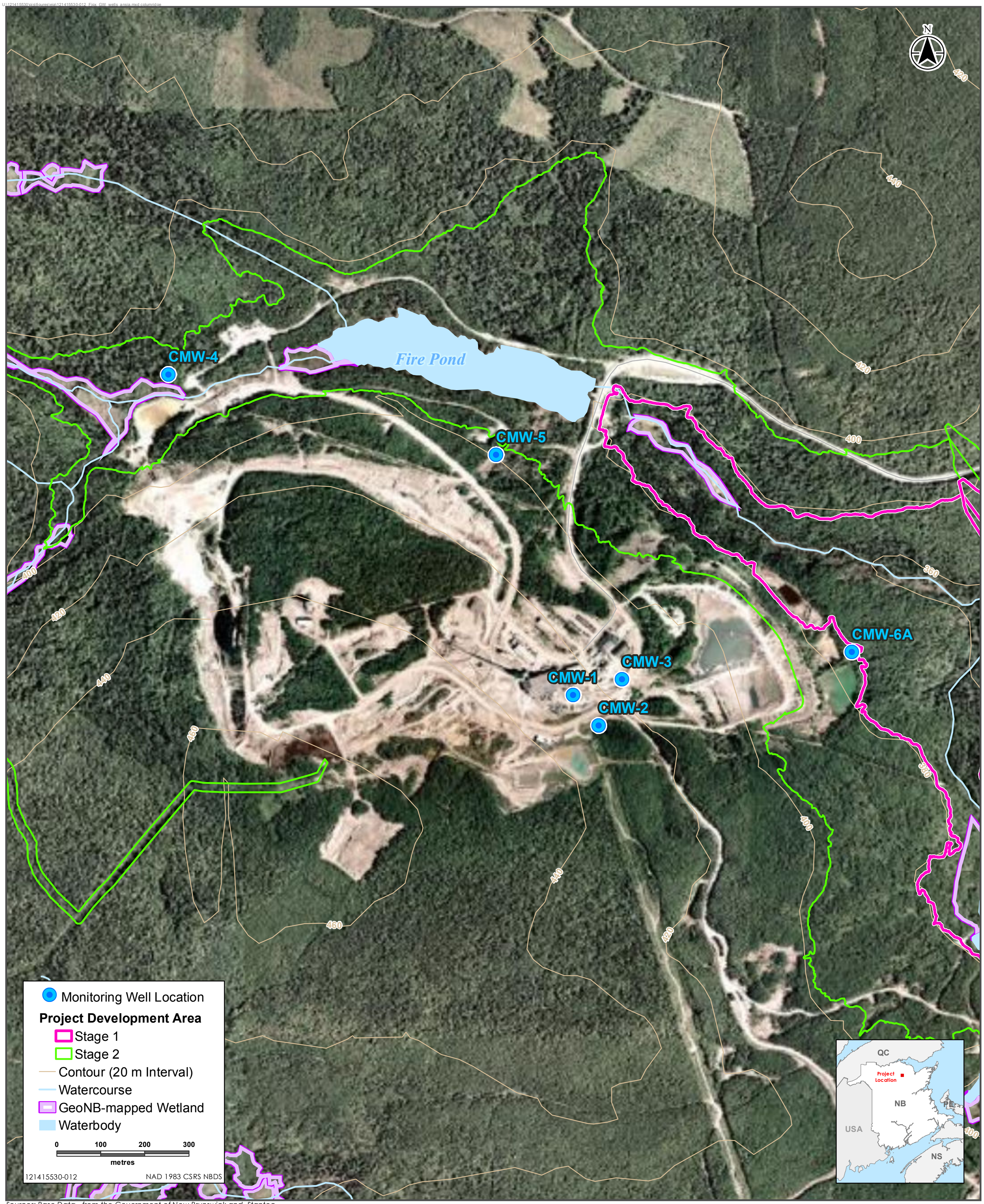
Table 5.10 Mean Groundwater Quality Statistics at Caribou Mine Monitoring Wells (2012-2017)

Parameter	Units	GCDWQ	CMW-1	CMW-2	CMW-3	CMW-4	CMW-5	CMW-6A
pH	-	7.0-10.5	4.97	4.85	5.78	5.45	3.99	6.88
Total Suspended Solids	mg/L	-	887	59.4	47.8	347	35.3	33.3
Conductivity	µS/cm	-	653	800	443	2,920	2,760	526
Hardness	mg/L	-	240	339	183	1,840	525	247
Total Acidity	mg/L	-	110	102	38.3	188	468	14
Sulphate	mg/L	500	255	418	186	1,730	904	182
Aluminum	µg/L	-	22,500	7,490	692	24,300	47,500	109
Arsenic	µg/L	10	9.14	1.91	1.23	21	1.64	1.45
Cadmium	µg/L	5	25.4	29.7	13.8	40.1	122	1.78
Calcium	µg/L	-	72,600	106,000	56,700	526,000	113,000	87,800
Copper	µg/L	1,000	6,110	3,600	2,190	3,860	18,200	32.4
Iron	µg/L	300	70,000	4,200	600	38,900	356	310
Lead	µg/L	10	640	14.9	5.92	42.2	27.9	4.96
Magnesium	µg/L	-	14,200	18,300	9,950	167,000	59,000	6,690
Manganese	µg/L	50	5,720	10,400	2,170	95,600	15,400	2,470
Mercury	µg/L	1	0.0789	0.0486	0.165	<0.025	<0.025	<0.025
Nickel	µg/L	-	47.8	85.6	16.6	583	190	5.5
Thallium	µg/L	-	0.145	0.155	<0.1	0.155	<0.1	0.136
Zinc	µg/L	5,000	15,800	19,200	8,760	37,200	95,600	1,480
Cyanide-Total	mg/L	-	<0.01	<0.01	<0.01	<0.01	<0.01	0.02

Notes:
GCDWQ = Guidelines for Canadian Drinking Water Quality (Health Canada 2017)
Bold Underlined values exceed the GCDWQ
Source: TMNBL

As shown in Table 5.10, the groundwater quality within the LAA is generally poor, with elevated concentrations of cadmium, copper, iron, lead, manganese, zinc, pH, and sulphate that exceed the GCDWQ (Health Canada 2017).

However, as there are no groundwater users in the immediate area, these exceedances do not pose a risk to human health at or near the site. However, the groundwater discharges to local surface water features, and has degraded the water quality in Forty Mile Brook, as discussed in more detail in Section 5.5.



Sources: Base Data - from the Government of New Brunswick and Stantec.
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Groundwater Monitoring Wells at the Caribou Mine

Figure 5.5

5.4.3 Potential Project Interactions with Groundwater

5.4.3.1 Construction Phase

Construction activities have the potential to interact with groundwater quantity by construction dewatering activities or blasting, should they be required. The primary effects of these activities include changes in water level that may affect groundwater users located within 500 m of the PDA, and changes to groundwater quality that may affect downgradient groundwater users, or discharges to surface water receptors. As no groundwater users are located within 500 m of the PDA, and since any dewatering activities will be short-term, groundwater quantity effects are not anticipated for the Project.

Construction activities will result in the temporary or permanent exposure of bedrock to the atmosphere. Groundwater quality may be degraded from construction activities in areas downgradient of bedrock formations containing sulphide mineralization that can potentially produce ARD when exposed to the atmosphere or oxygenated water. Groundwater downgradient of areas of high ARD potential may be degraded by decreased pH or increased concentrations of sulphides and dissolved metals. The potential effects are dependent on the sulphide mineral content of the bedrock, the size of the excavation and the time that the material is exposed, the hydraulic properties of the aquifer, the presence of naturally occurring buffering materials such as calcite within the rock mass or the associated overburden, and groundwater flow pathways.

The bedrock in the area of the construction is not known to have a high potential for ARD. However, an ARD management plan should be developed to manage rock with high ARD potential that may be exposed during construction activities. This could include the disposal of rock with high ARD potential excavated during construction into the NTTP or underground, or the placement of low permeability clay covers over areas identified to have high ARD potential.

5.4.3.2 Operation Phase

During operation, the flooding of the NTTP to Stage 1 will create an impoundment behind the dam to allow the subaqueous deposition of tailings within the TMF. The increased water level will alter the groundwater levels beneath the NTTP, and result in increased groundwater seepage within the footprint of the TMF through the shallow weathered bedrock. Perimeter engineered drainage collection channels at the toe of the NTTP dam will collect groundwater seepage and direct it to the polishing pond where it will either be blended with treated effluent, pumped back to the TMF for storage, or pumped to the water treatment facility for treatment. However, a portion of this seepage is expected to flow beneath the collection channels and polishing pond, and to eventually discharge to Forty Mile Brook. The rate of seepage is expected to increase as the water level in the TMF is raised during operation, but will eventually decrease as the tailings at the bottom of the NTTP consolidate, which will lower the hydraulic conductivity of the tailings and therefore limit the flux through the base of the TMF.

The storage of tailings and waste rock within the TMF may add a potential source of metals enrichment that may result in seepage of metal-enriched water beneath the TMF dam as groundwater seepage ultimately discharging to Forty Mile Brook. This seepage from the NTTP is anticipated to have water quality similar to the water quality in the STTP, as the tailings will have a similar quality and depositional environment in the NTTP as in the STTP.

Additional studies are required to quantify the potential change in downgradient water quality. Column tests are required to assess the effluent from the historical ARD tailings/waste rock and to improve the predictions of water quality. The results from this testing can be combined with groundwater flow modelling to predict the mass loading of parameters of concern from groundwater to Forty Mile Brook.

5.4.3.3 Closure/Post-Closure Phase

At closure, the flooding of the NTTP to Stage 2 will submerge areas that currently have poor groundwater quality including the historical Anaconda tailings, the former waste rock dump south of Fire Pond, and portions of the historical mine workings. Inundating these areas with freshwater is anticipated to reduce the rate of ARD reactions by limiting the amount of oxygen that can react on the surface of the waste rock and tailings. Therefore, the groundwater quality downgradient of these areas is anticipated to improve over time, as the ARD-impacted groundwater is flushed through the subsurface. This will improve the quality of the groundwater seepage beneath the NTTP dam, and therefore is expected to improve the water quality in Forty Mile Brook downstream of the NTTP.

Additional studies are required to quantify the potential change in downgradient water quality. Column tests are required to assess the effluent from the historical Anaconda tailings, and to improve the predictions of water quality. The results from this testing can be combined with groundwater flow modelling to predict the mass loading of parameters of concern from groundwater to Forty Mile Brook.

5.4.3.4 Mitigation for Groundwater

Potential Project interactions with groundwater will be managed through use of standard mitigation measures. This includes the development of an ARD management plan to manage activities that expose bedrock with a high ARD potential during construction activities.

The operation of perimeter engineered drainage collection channels at the toe of the TMF dam will collect a portion of this groundwater seepage and direct it to the polishing pond where it will either be blended with treated effluent, pumped back to the TMF for storage, or pumped back to the water treatment facility for treatment. Should groundwater seepage that bypasses the drainage collection system result in poor quality in Forty Mile Brook, groundwater pump-back wells could be installed to manage groundwater seepage by pumping it to the water treatment facility for treatment.

5.4.4 Summary for Groundwater

Groundwater pathways discharging to surface water are the primary interactions of the Project with groundwater, as there are no known groundwater users in the LAA. Baseline groundwater quality in the LAA is generally poor due to ARD effects to groundwater from historical mine operations.

The storage of water and tailings in the NTTP during operation is expected to increase the mass loading of some metals to Forty Mile Brook due to the increased seepage of groundwater under the footprint of the TMF. These effects are anticipated to be short lived and to decrease as the tailings at the base of the NTTP consolidate over time.

The NTTP is anticipated to have a net positive effect on the groundwater quality at closure by reducing the ARD reactions in historical waste rock and tailings disposal areas.

With effective implementation of mitigation and environmental protection measures, no substantive interactions of the Project components and activities with groundwater are anticipated. Groundwater quality monitoring during construction, operation, and closure will be completed to verify the effectiveness of the mitigation and environmental protection measures.

5.5 ASSESSMENT OF POTENTIAL INTERACTIONS WITH SURFACE WATER

This section assesses the potential environmental interactions between the Project and surface water.

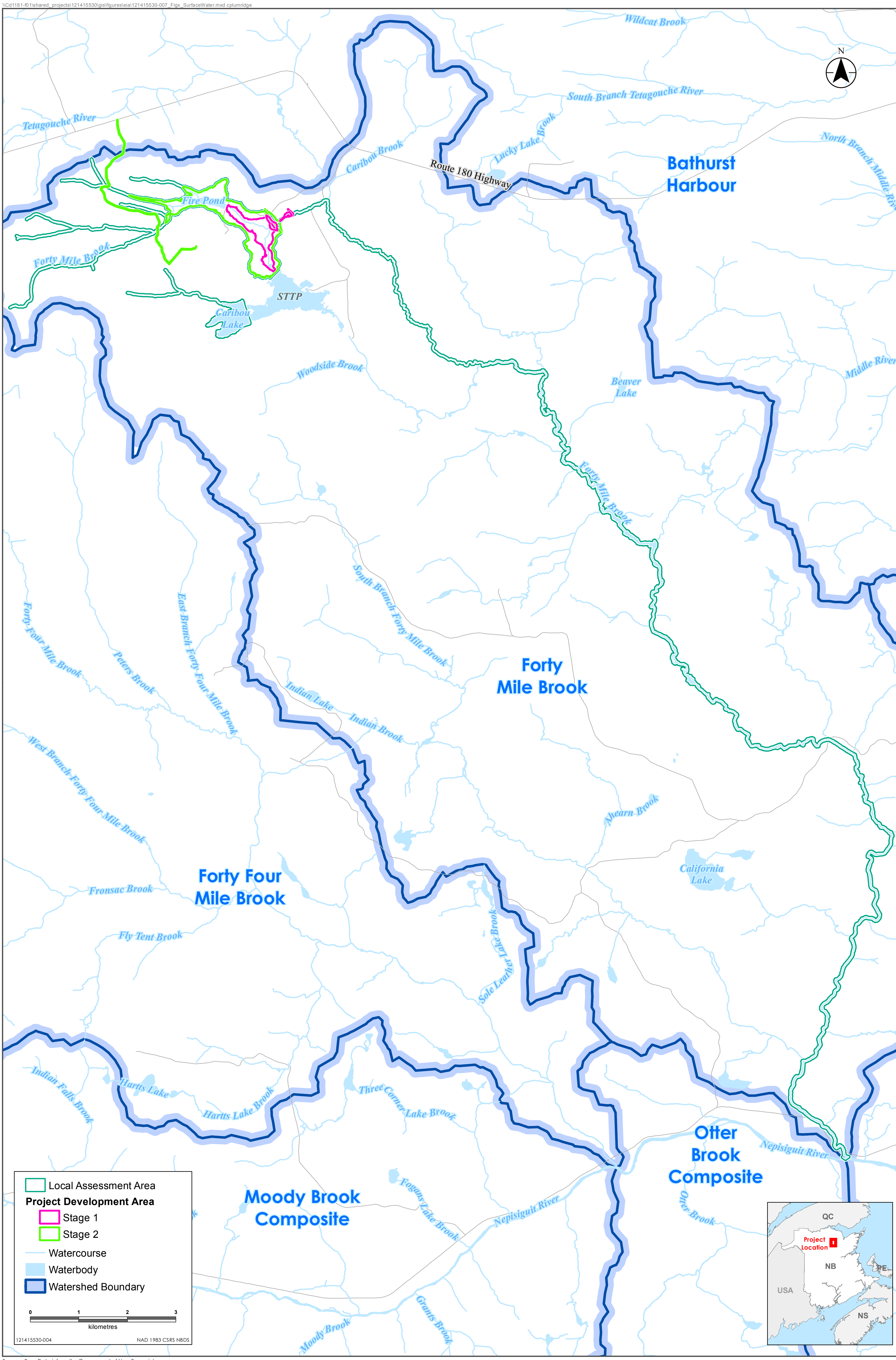
5.5.1 Scope of Assessment

Surface water was included as a VC because of the potential for the Project to interact with the flow regime of Forty Mile Brook and the importance of surface water to natural and human environments.

Surface water is a vital component to an ecosystem and is integrally linked to several other VCs discussed in this EIA Registration, including groundwater (Section 5.4), fish and fish habitat (Section 5.6), vegetation and wetlands (Section 5.7), and wildlife and wildlife habitat (Section 5.8). Potential interactions with surface water are focused on the change in the surface water flow regime, which includes both water quantity and water quality. Water quantity, primarily measured by stream flows and water levels, relates to key characteristics of a watercourse including the velocity, depth, and shape of the channel bottom; sediment transport; and ice flow regime. Water quality is measured by physical, chemical, and biological parameters, such as temperature, trace metals, total suspended sediment, and dissolved oxygen levels.

Provincially, the Caribou mine follows enforceable discharge requirements at its final discharge point (FDP) as set forth in the Approval to Operate I-10186 (NBDELG 2018a). Federally, the site is subject to the MDMER under the *Fisheries Act*, which pertains to all waters discharged from the facility's FDP and also provides enforceable discharge requirements. The Canadian Council of Ministers of the Environment's (CCME) "Canadian Environmental Quality Guidelines: Water Quality Guidelines for the Protection of Aquatic Life (Freshwater)" (CCME 1999a, hereinafter referred to as the CCME FAL guidelines) provide guidelines for various parameters in freshwater systems to protect aquatic life, though the guidelines have no force of law unless formally adopted by provincial regulation. Water quality will be compared to the applicable guidelines when assessing environmental interactions.

Surface water interactions are anticipated to occur within the areas identified as the surface water local assessment area (LAA; Figure 5.6). The LAA is the area within which environmental effects from the Project activities and VC can be predicted or measured with a reasonable degree of accuracy and confidence. For considering environmental effects on a change in surface water flow regime as a result of the Project, the LAA for the surface water VC extends 30 m from the PDA, and the observed high-water mark of the banks of the headwater streams to Forty Mile Brook (north and south tributaries), Caribou Lake, and Forty Mile Brook to the confluence with the Nepisiguit River (Figure 5.6).



Sources: Base Data is from the Government of New Brunswick.

Local Assessment Area for Surface Water

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Figure 5.6

5.5.2 Existing Conditions for Surface Water

5.5.2.1 Approach and Methods

The existing surface water conditions were characterized based on a review of previous studies conducted at the Caribou mine, published databases and digital maps were consulted. The databases and digital maps referenced for the Project include:

- Regulatory Information Submission System (ECCC 2018a);
- Environmental Effects Monitoring Cycle 1 Report (Stantec 2015a);
- Environmental Effects Monitoring Cycle 2 Report (Stantec 2018b);
- TMNBL LiDAR (Leading Edge Geomatics 2013);
- Environment Canada HYDAT database (ECCC 2018b);
- New Brunswick Digital Topographic Database (NBDELG 2013); and
- New Brunswick Hydrographic Network geographic dataset (NBDNR 2015).

5.5.2.2 Description of Existing Conditions

The footprint of the Caribou mine is located in the headwaters of Forty Mile Brook and includes the north and south tributaries. Caribou Lake, located upstream of the STTP, drains the upper portion of the south tributary to Forty Mile Brook watershed. Caribou Lake is approximately 280,000 m² in area and is a man-made lake created by the backwater of Caribou dam, which outlets to the existing diversion channel that by-passes the STTP and the existing polishing pond and mine FDP in the south tributary to Forty Mile Brook. The existing diversion channel is designed to provide fish passage from Caribou Lake to Forty Mile Brook. Located north of the mine site, the upper portion of the north tributary to Forty Mile Brook watershed drains into the Fire Pond. The Fire Pond outlets to the north tributary to Forty Mile Brook.

The main process water source for the Caribou mine is from the STTP, supplemented by water extracted from the Fire Pond as well as from Caribou Lake. At the current rate of milling, approximately 80% of the total water usage is recycled water. Fresh water sources for the mine site are supplemented by the Fire Pond and Caribou Lake. In addition to providing fresh water to the milling process, fresh water from Caribou Lake is also consumed underground, in the offices, at the warehouse and at the water treatment plant. All treated effluent from the mine process is discharged to the STTP for storage and additional treatment/sedimentation.

The STTP effluent is discharged to the polishing pond which serves as the FDP. Discharge to the polishing pond is controlled through three outlet pipes with gate valves and a concrete ogee (S-shaped) emergency spillway to prevent overtopping of the STTP dam. The minimum operational water level for the STTP is 458.15 m amsl, maintaining a minimum of a 1 m water cover over the deposited tailings as dictated by the provincial Approval to Operate. The maximum operational water level of the STTP is at the spillway elevation of 460.20 m amsl. The normal operation water level in the STTP pond fluctuates based on water quality needs and seasonal variations.

The STTP polishing pond discharge (PPD) consists of a free-flowing concrete box culvert outlet, fitted with a fish screen at the inlet. The outlet structure can be fitted with stop logs to temporarily increase the storage capacity in the PPD, which limits discharge from the pond while this additional storage is filled. The the polishing pond dam also includes an emergency spillway.

Watershed Characteristics

The Forty Mile Brook watershed is part of the Nepisiguit River watershed that flows to the Bay of Chaleur at the City of Bathurst. As shown in Figure 5.7, the north and south tributaries to Forty Mile Brook join the main branch of Forty Mile Brook just downstream of the mine. The Forty Mile Brook watershed was delineated into sub-watersheds (catchment areas) using available elevation contours. A total of five catchments that drain to the upper Forty Mile Brook system were delineated using GIS, as shown in Figure 5.7.

The topography of the Forty Mile Brook watershed includes forested rolling hills averaging a slope of 1-6% with flat low-lying areas and wetlands near the headwaters of Forty Mile Brook north and south branches. The NTTP is situated at a natural valley that narrows downstream of the confluence with the Forty Mile Brook north and south tributaries.

The watershed received an average of 1,099.9 millimetres (mm) of precipitation per year, based on the Canadian Climate Normal (1981 to 2010) for the Upsalquitch weather station (GOC 2018b). The majority of the precipitation occurs as rainfall, with snowfall accounting for an average of 329.7 mm per year (ECCC 2018b). The water balance model for the TMF estimates that these precipitation rates result in climate normal runoff volumes of 54,641 m^3/d at the proposed NTTP (Stantec 2018c).

The streambed and bank characteristics of Forty Mile Brook were characterized in a habitat survey completed by Stantec (2014). The average substrate composition in Forty Mile Brook for the reach between the confluence of the north branch and south branch tributaries to Caribou Brook included: 5 % fines (< 2mm), 15% small gravel (2-16 mm), 25% large gravel (17-64 mm), 25% cobble (65-256 mm), 20% boulder (257-462 mm), 10% large boulder (> 462 mm), and 0 % bedrock. The propensity for the stream bank to resist erosion was visually assessed to be 45% stable and 5% moderately stable for each left and right bank (Stantec 2015a).

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CATCHMENT AREAS - WATER MANAGEMENT PLAN
ENVIRONMENTAL IMPACT ASSESSMENT
CARIBOU MINE, NEW BRUNSWICK

Client: TREVALI MINING NEW BRUNSWICK LTD.

Job No.:	121415530.300
Scale:	1 : 30,000
Date:	12-JUL-2017
Dwn. By:	JL
App'd By:	MK

Fig. No.: 5.7

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Surface Water Uses

Approximately 80% of the process water requirements for the mine site comes from recycling water from the STTP at an average rate of 21,400 m³/day). Additional process water is also supplied from the Fire Pond at an average rate of 1,750 m³/d, with a peak permitted rate of 2,000 m³/d and from Caribou Lake at an average rate of 650 m³/d, with a peak permitted rate of 1,000 m³/d (NBDELG 2018a).

Caribou Lake is a manmade lake that was created as part of the fish habitat compensation plan for the construction of the STTP. Caribou Lake is now part of the New Brunswick Crown reserve network. During fishing season (which spans from June 1 to September 15), anglers can apply for daily fishing access to the lake.

Flow Regime

Routine monitoring of water levels and flow rates (i.e., hydrometric monitoring) of watercourses in New Brunswick conducted by the Water Survey of Canada (WSC) has established long-term records of flow regimes throughout the Province. However, no long-term hydrometric monitoring station is found on Forty Mile Brook. The long-term hydrometric monitoring station located on the Northwest Miramichi River at Trout Brook (station 01BQ001) was selected to characterize the flow regime for Forty Mile Brook at the proposed NTTP dam. This location is close to the site, has similar types of land use and topography, and has a long period of record (active between 1961 and 2012).

In order to compare flows from station 01BQ001 to Forty Mile Brook, flows between 1961 and 2012 were prorated based on Forty Mile Brook watershed areas relative to the drainage area upstream of the hydrometric station. Table 5.11 summarizes the minimum, mean, and maximum annual flow based on daily flow records from station 01BQ001, and the calculated flows at four locations within the Forty Mile Brook LAA. The mean annual flow (MAF) at the NTTP dam is estimated to be 0.64 m³/s.

Table 5.11 Flow Regime Characteristics of Forty Mile Brook – Prorated from Northwest Miramichi at Trout River (Station 01BQ001)

Location	Period of Record	Annual River Flow (m³/s)			†Watershed Area Contributing to the Hydrometric Station (km²)
		Minimum	Mean	Maximum	
Northwest Miramichi at Trout River (01BQ001)	1961–2012	1.42	21.6	487	948
Forty Mile Brook – North Tributary	--	0.02	0.28	6.32	12.3
Forty Mile Brook – South Tributary	--	0.01	0.20	4.57	8.9
Forty Mile Brook – STTP	--	0.01	0.08	1.90	3.7
Forty Mile Brook – Main Branch at NTTP Dam	--	0.04	0.64	14.33	27.9

Note: †Forty Mile Brook flows are prorated from Northwest Miramichi at Trout River (Station 01BQ001)

The calculated mean daily flow hydrograph for the main branch of Forty Mile Brook at the NTTP is presented in Figure 5.8. The seasonal high flow corresponding to the spring freshet typically occurs in April and May, with seasonal low flows typically occurring in the winter (February) and in the summer (July, August, September). Mean annual flow rate is consistent with the mean annual climate normal runoff volume calculated in the NTTP water management plan (Stantec 2018c).

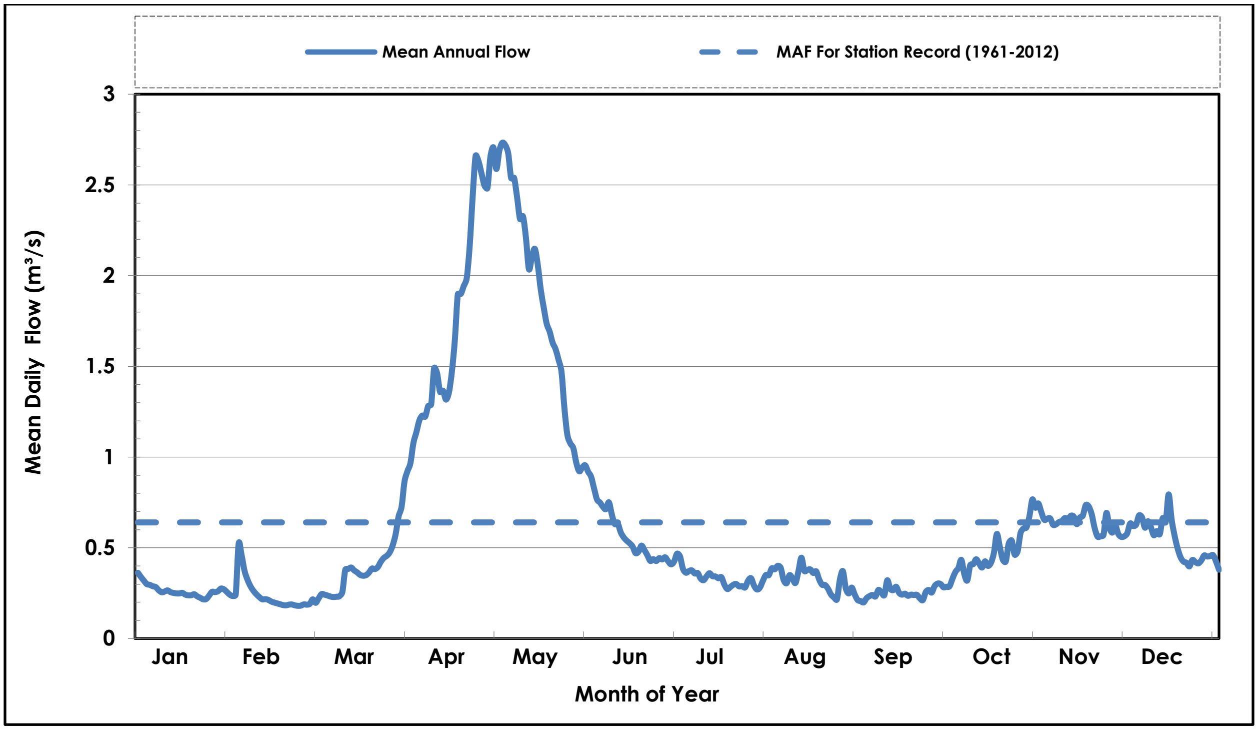


Figure 5.8 Estimated Mean Daily Flow of Forty Mile Brook at North Tributary Tailings Pond

Water Level Management at the STTP

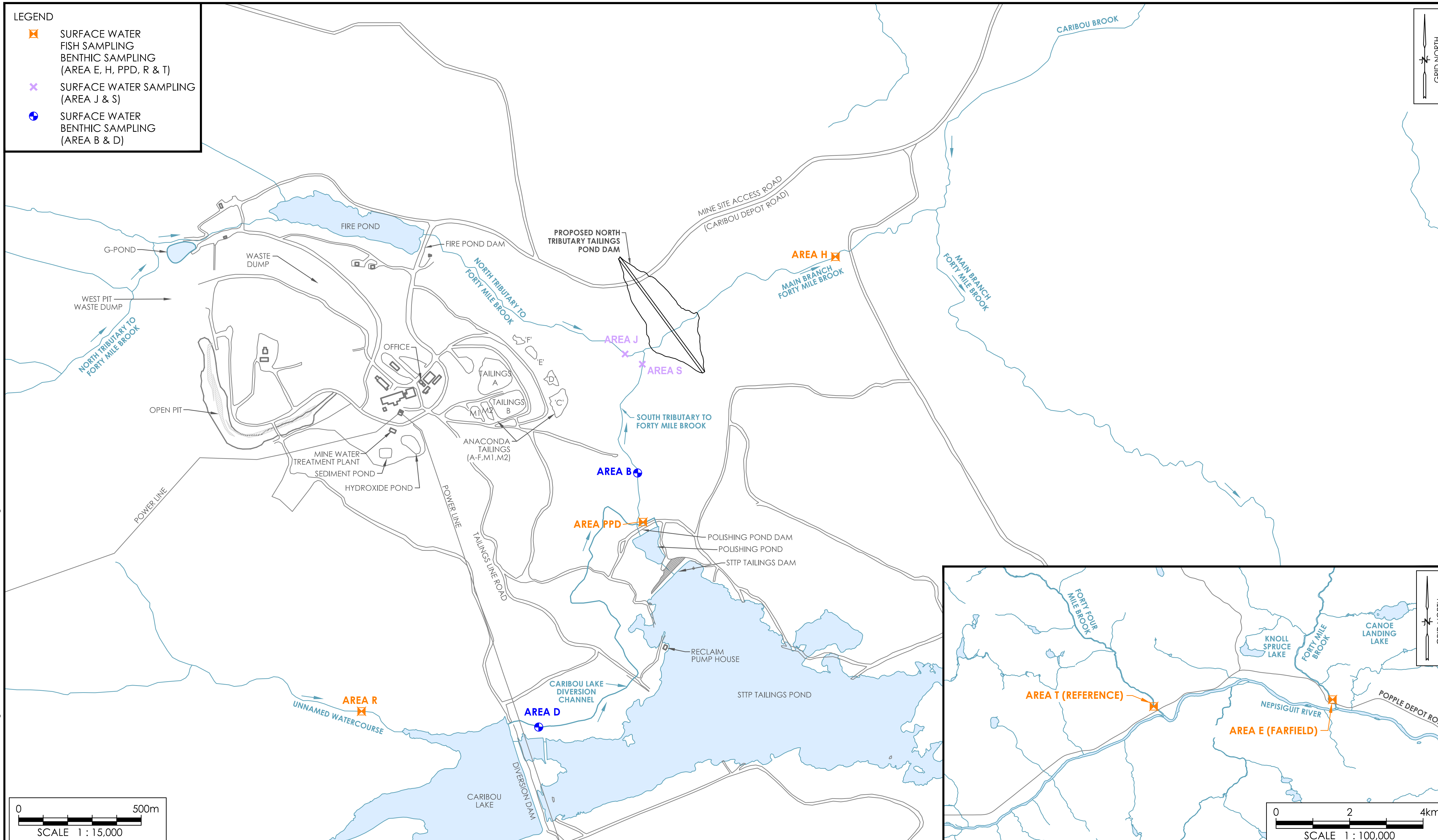
The water level in the STTP is managed according to operational demands and seasonal variations in inflows. In addition, lowering of the STTP allows for the proper management of the spring freshet by providing additional storage capacity available within the STTP. During the spring and summer months, water level in the STTP remains near the normal operating water level (NOWL) of 458.15 m amsl to maintain sufficient water cover over the tailings and to provide sufficient process water to the milling complex. The STTP water level typically varies within a 2.0 m range over the course of a year.

Ice Management at the STTP

The STTP is covered with ice during the winter months. The tailings discharge line is placed in a deep section of the STTP, as determined by an annual bathymetry survey, during the fall as it must remain stationary during the winter months. The STTP discharge valves and intake block are housed within an enclosed heated building to allow the operation of the valves during the winter months. The emergency spillway is regularly inspected for ice blockages and other debris. In the event that ice build-up becomes an issue at the STTP discharge location, aerators are installed to agitate water to prevent and/or minimize the formation of ice. No major issues with ice management have been reported at the STTP tailings discharge.

Water Quality

The regulated FDP for the Caribou mine is located at the polishing pond discharge (Area PPD). This location is sampled five days per week and analyzed for pH and metals including zinc, copper, and lead. In addition, toxicity testing for rainbow trout and *Daphnia magna* are conducted once per month as required by MDMER, while sub-lethal testing is conducted twice yearly at Area PPD. Water quality parameters at the FDP are regulated under the provincial Approval to Operate as well as under Schedule 4 of the federal MDMER, and water is also sampled at a number of locations in Forty Mile Brook, downstream of the mine site. The sampling locations on Forty Mile Brook, the Nepisiguit River, and Forty-Four Mile Brook are shown in Figure 5.9.



THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC CONSULTING LTD. REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.

Reference:

1. WATERCOURSE DATA OBTAINED FROM AVAILABLE INFORMATION LICENCED UNDER THE GEONB OPEN DATA LICENCE.
2. CANZINCO LTD. CARIBOU MINE GENERAL SITE PLAN; DWG. No. CB97-01.

SAMPLING LOCATIONS WITHIN THE LOCAL ASSESSMENT AREA

ENVIRONMENTAL IMPACT ASSESSMENT
CARIBOU MINE, NEW BRUNSWICK

Client: TREVALI MINING NEW BRUNSWICK LTD.

Job No.:	121415530.300
Scale:	AS SHOWN
Date:	12-JUL-2018
Dwn. By:	JL
App'd By:	MK
Fig. No.	5.9

Stantec

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Based on a review of the water quality data presented in the 2015 and 2018 EEM reports (Stantec 2015a; Stantec 2018b), water quality at Area PPD meets provincial and federal discharge requirements. Trace metals, TSS, nutrients and *in-situ* water quality results have been recorded at various locations throughout the Forty Mile Brook and Nepisiguit River watersheds and compared to the MDMER Schedule 4 requirements as well as to the CCME FAL guidelines (where applicable), as shown on Figure 5.10.

Records at the FDP (Area PPD) for pH over the period of 2014 to 2017 remained between 7.3 and 7.4. The highest metal parameter concentration was zinc with a concentration of 570 µg/L, which is below the regulated MDMER maximum grab concentration limit of 1,000 µg/L. Water quality parameters such as cadmium, copper, lead, selenium, thallium and zinc exceeded the CCME FAL guidelines but remained well within the provincial and federal limits (where applicable) (Figure 5.10).

Historical mining activities at the site have altered the water quality on portions of the north and south tributaries to Forty Mile Brook (Environment Canada 1972-1975; Anaconda Company 1976; Jacques Whitford 1996, 1997; Montreal Engineering 1980; Currie 1988; Stantec 2015a, 2018a). As was discussed for groundwater in Section 5.4.2.2.4, surface water quality data show elevated metal concentrations in Forty Mile Brook downgradient of the historical Anaconda tailings and historical waste rock stockpiles compared to other monitoring stations. Results in the north tributary to Forty Mile Brook (Area J), located downgradient of the historical waste rock stockpiles routinely show elevated concentrations for aluminum, cadmium, copper, zinc and depressed pH that exceed the CCME FAL guideline limits by several orders of magnitude. Water chemistry in the main branch of Forty Mile Brook (Area H), downstream of Area J, is also characterized by elevated concentrations of aluminum, cadmium, cobalt, copper, total suspended solids, nickel, and zinc and depressed pH, but at values that suggest the dilution of water quality originating at Area J (Stantec 2015a).

Trace metal concentrations for surface water in Forty Mile Brook upstream of the confluence with the Nepisiguit River (Area E) are generaly similar to reference areas (i.e., Area R) on the south tributary to Forty Mile Brook, indicating that the water quality effects from the historical mine operations are reduced further downstream from the mine site. In 2017, an additional baseline water quality monitoring area was sampled at the mouth of Forty-Four Mile Brook (Area T) (Stantec 2018b). Since the habitat characteristics of Forty-Four Mile Brook (non-impacted) are similar to the habitat found on Forty Mile Brook (impacted), this new sampling area (Area T) is proposed to become a baseline monitoring station to assess the potential water quality changes associated with the Project.

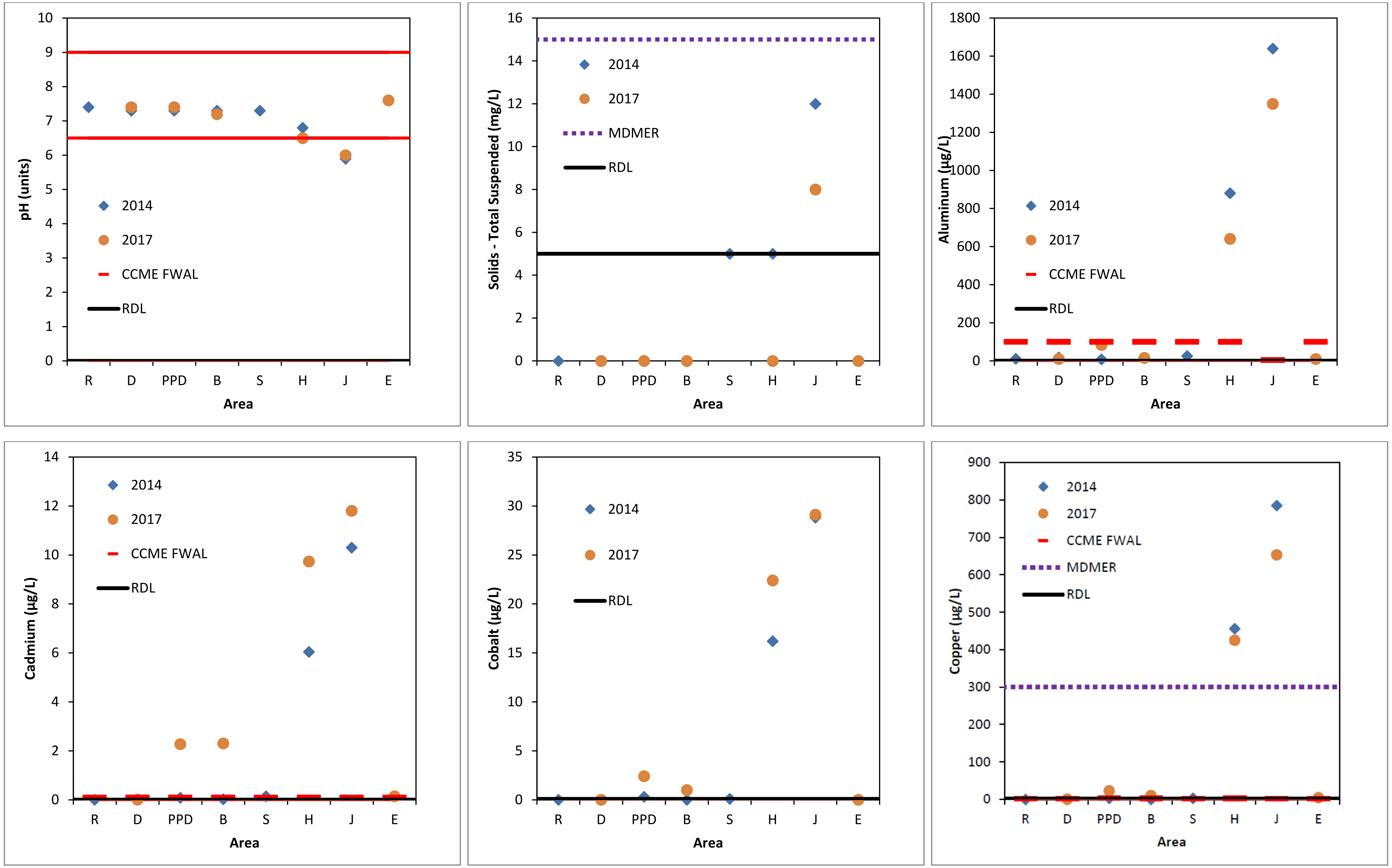

Figure 5.10 Summary of Water Quality Results for pH, Solids, Aluminum, Cadmium, Cobalt and Copper

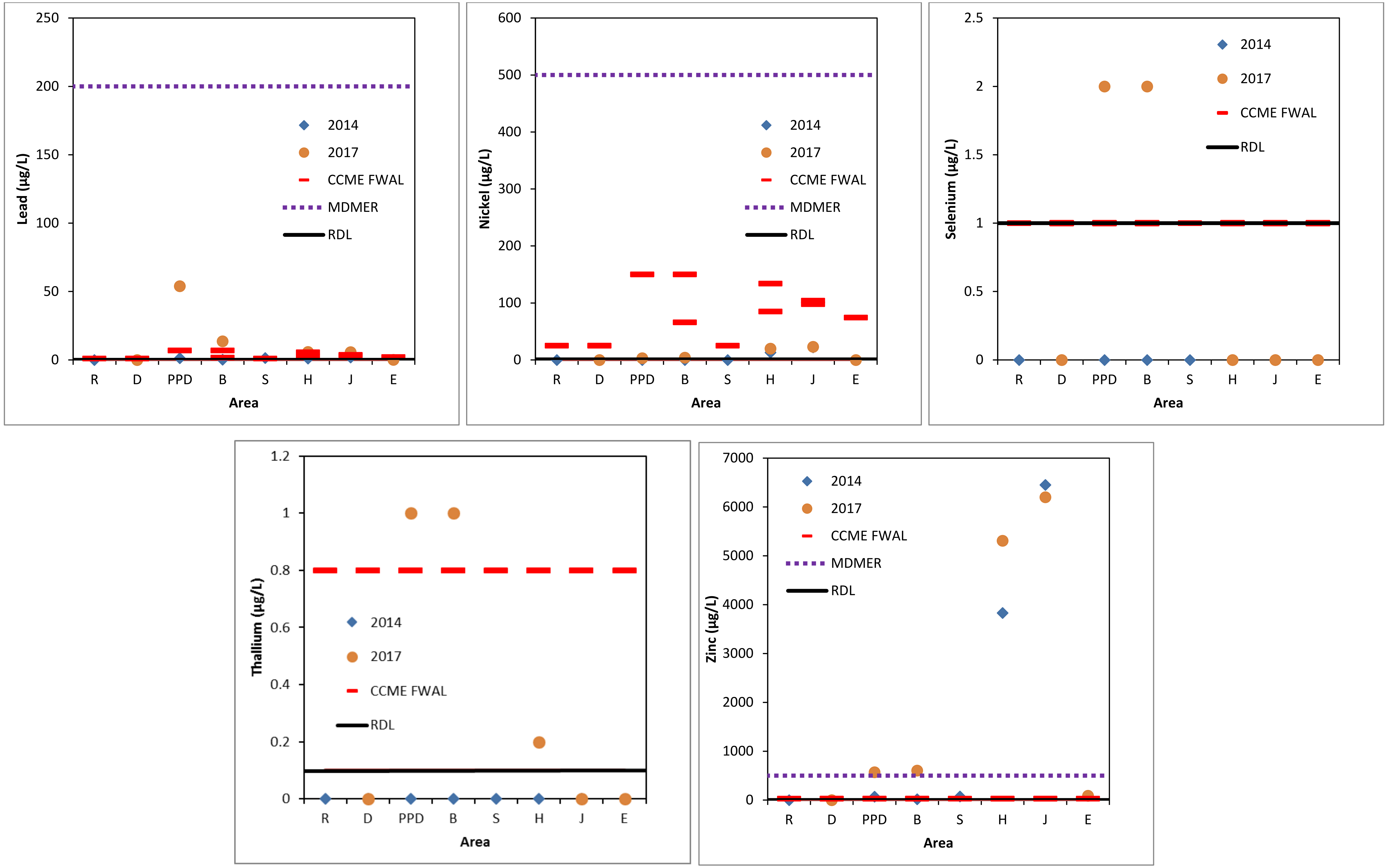

Figure 5.11 Summary of Water Quality Results for Lead, Nickel, Selenium, Thallium and Zinc

5.5.3 Potential Project Interactions with Surface Water

This section describes how Project components and activities could interact with surface water and the techniques and practices that will be applied to mitigate these potential interactions.

5.5.3.1 Construction Phase

Sediment Transport to Forty Mile Brook

Construction activities within 30 m of a watercourse, such as clearing, grubbing, and grading/leveling activities necessary for site access and proposed TMF area (Stage 1), as well as ground breaking required for construction of the main TMF dam and the polishing pond dam, will result in areas of physical disturbance susceptible to erosional runoff. The operation of machinery in or near a watercourse during the construction of the Stage 1 components within the waterway, such as the cofferdam, may also result in soil mobilized by equipment and an increase in suspended sediment concentrations in water. Mobilization of sediments to a watercourse may result in a change to surface water quality if not properly managed due to an increase in total suspended solids, metals and nutrient concentrations, water temperatures, or a combination thereof. As described in Section 2.8, standard mitigation measures and best management practices will be implemented through the TSSEMP that will reduce the potential release of sediment to watercourse.

Parameters such as total suspended solids will be measured upstream and downstream of the PDA periodically throughout construction, in accordance with the TSSEMP and any permitting requirements for the Project (such as the WAWA Permit).

Change to Water Quality due to Sediments

Construction of the Stage 1 TMF dam will be completed mostly under dry conditions to reduce the risk for sediment to enter the river. In-water work will be necessary for the construction of the upstream cofferdam (Stage 1); however, this activity will enable further work to be conducted under dry conditions. The cofferdam will be installed upstream of the main dam construction area and the water diverted around the entire construction area (i.e., around the main TMF dam and polishing pond dam). The cofferdam will be constructed with clean non-sulphide bearing rock fill or till to decrease the amount of sediment introduced to the river and the introduction of acid-bearing sulphides.

Existing quarries and/or new quarries will be developed in order to provide the aggregate source for the construction of the NTTP dam and polishing pond dam. Water accumulating in the quarries either from groundwater sources and/or from precipitation will be pumped out in order to carry out quarrying operations. The water will likely have elevated levels of TSS due to the activities being carried out in the quarry. The water will be pumped to a sedimentation pond(s) which will allow the sediments to settle prior to the water being discharged into the receiving environment. Proper erosion control measures and best management practices will be implemented during this phase of and throughout the Project in order to avoid unnecessary sedimentation to the receiving environment.

Other activities, such as the possible relocation of the reclaim pumphouse, and the construction of the new water treatment plant, and associated utilities, will be completed in the dry and proper erosion control measures will be implemented during construction.

Construction activities related to these Project components will result in some in-stream sedimentation, even after implementation of appropriate erosion and sediment control measures. It will be impractical to assume that erosion and sediment control measures will be 100% effective and some minor and short-term in-stream sedimentation and erosion is likely as a result of construction. Turbidity curtains will be installed around the perimeter of the downstream work area to control suspended sediments to the work area. Sedimentation and erosion will be further reduced by conducting in-stream work during periods of lower flow and over the shortest duration possible based on conditions present at the time of construction. Given effective implementation of mitigation and the proper management of water volumes around work areas, increases in sediment levels, should they occur, are anticipated to be localized and minor.

Change to Water Operating Level

To facilitate construction (Stage 1), water levels in the STTP and in the Fire Pond will be lowered prior to the start of construction, and these lowered water levels will be maintained for up to 8 months, or until construction within the channel is complete. Drawdown will be carefully controlled through the STTP discharge valves and the removal of stop logs at the Fire Pond spillway to gradually release water from these facilities to avoid sudden changes in flow downstream of the main branch of Forty Mile Brook. During this period, the water level in the STTP will be maintained such that a minimum of 1 m water cover is maintained over the deposited tailings. The drawdown of the STTP and Fire Pond is anticipated to be complete a few weeks prior to the start of construction. Drawdown will be completed in June after the spring freshet has passed through the system. Lower operating water levels will result in a temporarily-reduced wetted perimeter in the Fire Pond, but is not anticipated to affect the flow rate through the Fire Pond after the water level has been lowered. In order to minimize disruption to the milling and mining processes, the water level will be lowered so that process water intakes are still useable.

Drawdown of the STTP and the Fire Pond will cause a temporary increase in flows in the main branch of Forty Mile Brook during the drawdown period. Erosion or scour as a result of the increased flow is anticipated to be negligible relative to the existing flow of Forty Mile Brook, due to the gradual changes in flow during the drawdown period and the channel type (i.e., bedrock, boulders and cobble).

Upon commissioning of Stage 1, downstream flows will be reduced from natural flow conditions as the NTTP is filling to normal operating water level. During this period of initial filling, base flow requirements in Forty Mile Brook will be maintained downstream of the dam by either using mechanical pumping and/or gravity drainage.

The introduction of a dam on a watercourse may be beneficial by mitigating floods at certain times of the year and regulating flow during low flow periods. Other impacts may include changes in flow regime, river channel processes, water chemistry and temperature.

5.5.3.2 Operation Phase

Change to Water Quality

Under normal operating conditions, sediment inputs (if any) from construction activities should no longer be of concern since construction work will be complete and all effluent exiting the TMF will be treated as required prior to discharge at the FDP.

Current water quality within Forty Mile Brook indicates that the brook quality is already impaired by metal leaching resulting from historic ARD in the run-off and groundwater seepage from historical mining operations. The storage of tailings and waste rock within the NTTP will add a potential source of metals enrichment that may result in seepage of metal enriched water through the NTTP dam and into the groundwater under the NTTP, ultimately discharging to Forty Mile Brook. Perimeter engineered drainage collection channels at the toe of the dam are anticipated to collect most of this seepage and direct it to the NTTP polishing pond where it will either be mixed with treated effluent and/or pumped back to the water treatment facility for treatment.

During the Stage 1 operation, tailings will be deposited sub-aqueously within the TMF similar to current conditions to minimize the potential for metal leaching and acid rock drainage. It is anticipated that the NTTP water quality will be similar to current conditions in the STTP where the water will be alkaline (pH = 7-9) and will contain trace metals, total suspended solids, nutrients as well as other compounds associated with the milling and mining processes. Water quality within the NTTP will be managed using lime-based treatment process which can be either applied from one or more of the following locations: the milling complex, the STTP lime plant, or from the Caribou water treatment facility.

Additional water quality modeling and kinetic testing of the tailings and waste rock will be required to determine the water quality in the TMF, and if additional water treatment will be required under Stage 1 relative to the current treatment methods. More specifically, the storage of historical ARD waste rock and tailings generated from satellite ore feed(s) may have different leaching characteristics as current feed sources (i.e., Caribou and Restigouche Mines) and may further affect the TMF water quality. This work will be undertaken as required within the next few months and will be submitted under separate cover.

As described in Section 5.5.2, water quality within Forty Mile Brook is impaired by historical ARD runoff and groundwater seepage from the mine site. The operation of the NTTP is anticipated to have a positive effect on the water quality by capturing surface ARD runoff and groundwater seepage that are currently leaching metals into the brook. Under Stage 1, mine contact water collected at the site will be treated prior to discharge to the environment and will be required to meet provincial and federal regulatory requirements. This is anticipated to improve the water quality in Forty Mile Brook downstream of the TMF and polishing pond. Water quality characterization work will be undertaken in the coming field season to determine the extent of the current contamination to establish baseline conditions. It is anticipated that water quality monitoring will be undertaken downgradient and downstream of the TMF to monitor long-term water quality improvements in the Forty Mile Brook.

Change to Water Quantity

During the operation phase, it is anticipated that the newly-constructed NTTP will be managed in a similar manner as the STTP whereas the water level will be managed according to operational and seasonal requirements.

The sequestration of water during the operation phase, including precipitation and runoff falling within the PDA upstream of the dam, within the tailings voids, plus evaporation from the TMF headpond, will reduce the amount of surface water available for process and/or for aquatic requirements in the future, both downgradient and downstream. These reductions are not anticipated to have a major effect on the receiving environment since mine contact water is already sequestered in the current STTP and process water will be recycled at a rate of 80%, with excess water from the TMF treated and released on a continuous basis to meet base flow requirements in Forty Mile Brook.

5.5.3.3 Closure/Post-Closure Phase

Closure/post-closure includes the construction of the expanded (Stage 2) TMF by raising the Stage 1 dam height, and a new alternate site access road. The construction of the dam raise will be completed in the dry on the downstream face of the Stage 1 dam, and will be enclosed within the existing polishing pond area which can further mitigate erosion issues by providing further settling. Modifications to the emergency spillway and discharge structure will be completed in the dry by lowering the NTTP prior to construction. Drawdown of the NTTP and erosion control measures will be completed in a similar fashion as described for Stage 1.

As with the Stage 1 construction, standard mitigation measures and best management practices will be implemented through the TSSEMP that will reduce the potential release of sediment to the watercourse.

Physical construction of the alternative access road and internal site roads within the PDA may interrupt overland flow drainage patterns and watercourse crossings, and will be mitigated with properly-sized culverts and standard sediment control mitigation measures. Roadside ditches will route overland flow to local watercourses with appropriate sediment control measures in place. Such measures will be incorporated into design and described in the TSSEMP.

At closure of the NTTP (either coinciding with the closure of Caribou mine or at a later time if toll milling of satellite ore deposits is pursued), the water treatment facility will remain in operation for a minimum of three years following the last deposit of tailings in the TMF, with provisions for long-term mine water treatment as determined during the initial three years. Water treatment activities will only cease if/when provincial and federal water quality parameters are met at the final discharge point without water treatment. In the interim, the water treatment facility will continue to be maintained and serviced.

The TMF water level will be managed in accordance with seasonal and water quality requirements. If the TMF water quality does not require further treatment to meet regulatory requirements, passive engineered water discharge structures will be installed to reduce on-going operational oversight requirements.

5.5.4 Summary for Surface Water

To facilitate construction, water levels in the STTP and Fire Pond will be lowered temporarily, resulting in a reduced wetted perimeter for the Fire Pond and river depth upstream of Fire Pond. Water intake structures in the STTP and Fire Pond will be protected so to not disrupt mining and milling operations by maintaining minimum water cover. Construction activities within 30 m of a watercourse and in-water work may result in some instream sedimentation and a change to surface water quality if not properly managed. Standard mitigation measures and best management practices will be implemented through the SSEMP that will reduce the potential release of sediment to watercourses.

Upon commissioning of Stage 1 (and Stage 2 during closure), downstream flows will be reduced from natural flow conductions as the NTTP is filling to normal operating water level. Baseflow criteria will be implemented during these periods to maintain sufficient water downstream of the TMF while it is being flooded.

The construction of the TMF will have a net positive effect on the water quality in Forty Mile Brook by capturing surface ARD runoff and groundwater seepage that are currently leaching metals into Forty Mile Brook. As currently, all mine contact water will be treated prior to discharge to the environment and will be required to meet provincial and federal regulatory requirements, which is anticipated to significantly improve water quality downstream of the TMF.

With effective implementation of mitigation and environmental protection measures, there will not be any substantial negative interaction between the Project components and activities and the surface water flow regime (water quality and quantity) during all phases of the Project compared to current conditions with the existing operation of the mine, except that water quality may be significantly improved upon Project completion. Water quality monitoring during construction upstream and downstream of the PDA will be completed throughout construction to verify the effectiveness of the mitigation and environmental protection measures.

5.6 ASSESSMENT OF POTENTIAL INTERACTIONS WITH FISH AND FISH HABITAT

This section assesses the potential environmental interactions between the Project and fish and fish habitat.

5.6.1 Scope of the Assessment

Fish and fish habitat was selected as a VC because the Project lies within the Nepisiguit River watershed which contains commercial, recreational, and Aboriginal (CRA) fisheries that are protected by federal and provincial legislation. For the purposes of this VC fish are defined in the *Fisheries Act* as "*parts of fish, shellfish, crustaceans, and any parts of shellfish, or crustaceans, and the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish and crustaceans*". The assessment also includes aquatic species at risk (SAR) and aquatic species of conservation concern (SOCC) which are defined as follows:

- SAR are species listed as *extirpated*, *endangered*, *threatened*, or *special concern* under Schedule 1 of the federal *Species at Risk Act* (SARA), the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), or the New Brunswick *Species at Risk Act* (NB SARA).
- SOCC are species that have been identified by federal and/or provincial species at risk agencies as being rare in New Brunswick, or their populations may not be considered sustainable. SOCC are here defined to include species that are not SAR, but are ranked S1 (*critically imperiled*), S2 (*imperiled*), or S3 (*vulnerable*) in New Brunswick by the Atlantic Canada Conservation Data Centre (AC CDC).

DFO's Fisheries Protection Policy Statement (DFO 2013a) applies to projects that are likely to adversely affect fish or fish habitat that support CRA fisheries. Section 35 of the *Fisheries Act* includes a prohibition against causing "serious harm" to CRA fisheries, while Sections 20 and 21 provide provisions for flow and passage. DFO defines "serious harm" to fish as including the death of fish, the permanent alteration to fish habitat, or the destruction of fish habitat at a scale that may result in population level effects. Ultimately, these provisions aim to foster sustainable and productive fisheries in Canada. The potential for the Project to result in environmental effects on fish and fish habitat is evaluated in this VC using the concept of serious harm, considering Project effects after consideration of avoidance, mitigation, and offsetting strategies.

The potential effects of environmental stressors on fish and fish habitat are typically intertwined. Specifically, changes to the quality or quantity of fish habitat can influence fish populations. For the purposes of this VC, a potential environmental effect resulting from the Project is defined as a change in fish populations and/or fish habitat. If unmitigated, the Project has the potential to change fish populations and/or fish habitat in a manner that could lead to serious harm.

The LAA for fish and fish habitat is defined as the potential zone of Project interactions with fish and fish habitat. For this VC, the LAA extends from the headwaters of the north and south tributaries to Forty Mile Brook to the confluence of Forty Mile Brook and the Nepisiguit River (35 km downstream of the Caribou mine) (Figure 5.12). The LAA also includes the area that extends 30 m from the observed high water mark of the banks into the riparian area of Forty Mile Brook and its tributaries (north and south tributaries), as well as the PDA.

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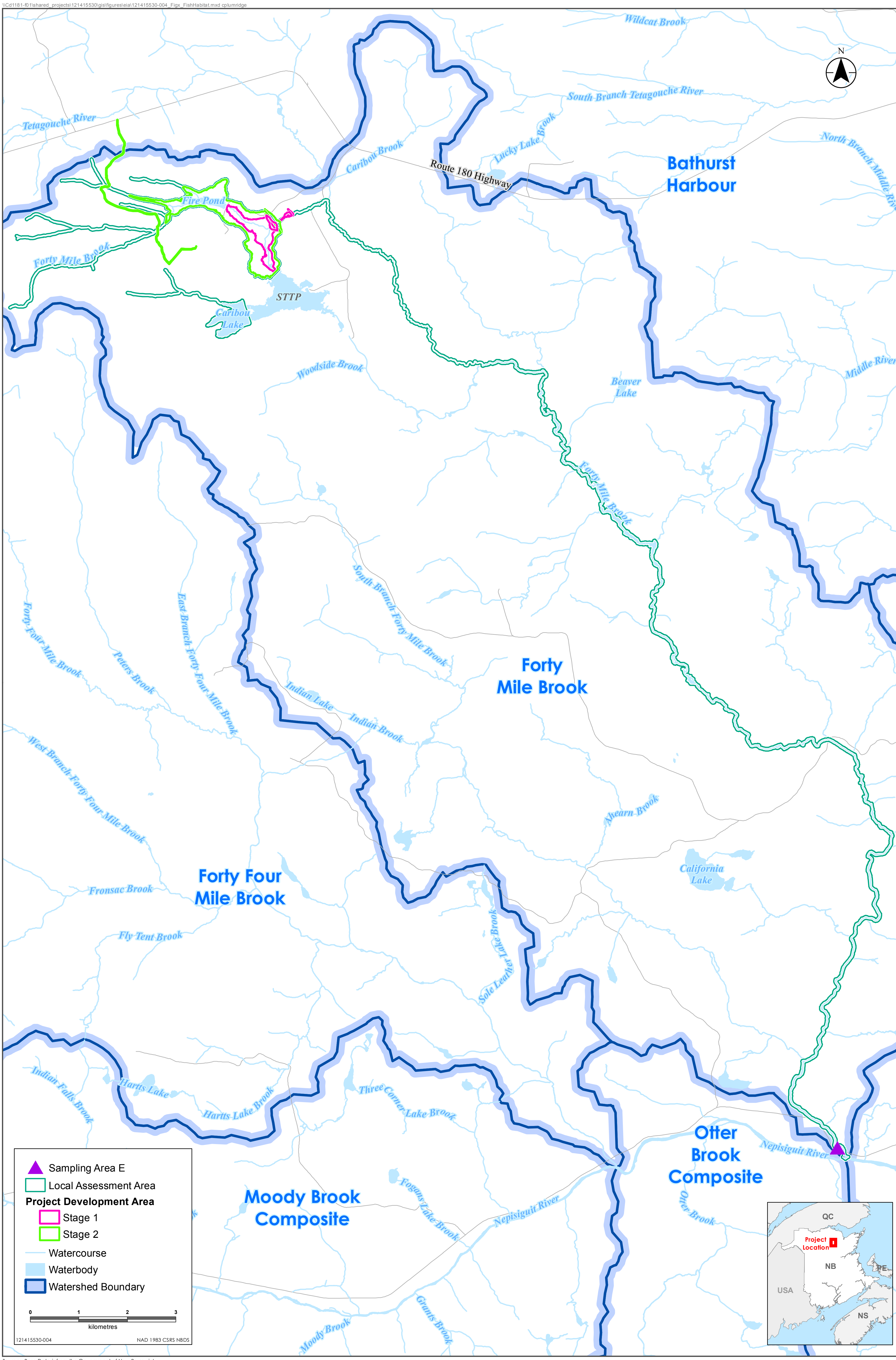

Sources: Base Data is from the Government of New Brunswick.

Local Assessment Area for Fish and Fish Habitat

Stantec

121415530 - TREVALI MINING (NEW BRUNSWICK) LTD.

Figure 5.12

5.6.2 Existing Conditions for Fish and Fish Habitat

This section characterizes the existing conditions of the LAA with respect to fish populations and fish habitat.

5.6.2.1 Sources of Information

No field studies were carried out specifically for this VC. However, considerable information is available on the aquatic environment as a result of Environmental Effects Monitoring (EEM) conducted in September 2014 and 2017 under the *Metal and Diamond Mining and Effluent Regulations* (MDMER) at the Caribou mine for its current operations. The following sources of information were used to characterize the existing conditions for this VC:

- Caribou mine - Cycle 1 Interpretive Report for EEM (Stantec 2015a);
- Caribou mine - Cycle 2 field data collection and Interpretive Report for EEM (Stantec 2018b);
- Data requests from NBDERD and the Nepisiguit Salmon Association (Connell, C., pers. comm., 2017; Nepisiguit Salmon Association 2011-2017);
- Nepisiguit Falls Generating Station Modification and Rehabilitation Project Environmental Impact Assessment (Stantec 2011);
- Supplemental information from NB Power on the Nepisiguit Falls Generating Station Modification and Rehabilitation Project Environmental Impact Assessment (Stantec 2013);
- Publicly available aerial imagery;
- Supplemental information from Caribou mine; and
- Publicly available scientific information.

5.6.2.2 Fish Habitat

The Caribou mine is located in the headwaters of Forty Mile Brook, a tributary to the Nepisiguit River which drains into Nepisiguit Bay and Chaleur Bay, approximately 45 km west of Bathurst. The quality and quantity of fish habitat in the area has been highly influenced by current and past mining activities. Due to the historical nature of the mine site and the lack of environmental knowledge on the effects of ARD in the 1960s, several locations along the north and south tributaries to Forty Mile Brook are affected by the historical tailings (Stantec 2015a). Figure 5.9 shows the areas within the LAA that are discussed below, which have been sampled through EEM.

South Tributary to Forty Mile Brook

The fish habitat within the south tributary to Forty Mile Brook varies based on its location relative to current effluent inputs and historical legacies at the Caribou mine, and can be broken into five reaches which include the headwaters of south tributary to Forty Mile Brook, Caribou Lake, the existing Caribou Lake diversion channel, the unnamed tributary to Forty Mile Brook, and the lower reach of the south tributary to Forty Mile Brook (Figure 5.9).

The unnamed tributary upstream of Caribou Lake (Area R) and of the STTP within the headwaters of the south tributary to Forty Mile Brook at the Caribou mine. This area is located outside of the influence of the Caribou mine effluent discharge and the historic mining legacies at the site (Stantec 2015a). The headwaters of the south tributary to Forty Mile Brook has a low gradient of 1.5 to 2%, with steeper grades upstream, and consists of shallow impoundment, shallow pool, and riffle habitat types. At the time of the most recent survey in 2014, there was a beaver dam located just below the inlet of the brook with Caribou Lake. Water depths range from 0.15 to 0.36 m. Stream widths range from 2.5 to 4.3 m. Substrate is characterized by fines (sand), gravel, and boulder, with small amounts of both bedrock and organic materials. There are small amounts of woody debris (5 to 15%) throughout the watercourse, and instream cover was provided by boulders, water clarity (e.g., turbulence, colour, turbidity), and small amounts of instream vegetation. Stream side vegetation is dominated by shrubs, grasses and conifers (Stantec 2015a). Representative habitat is provided in Photo 1.

Photo 1 Representative Habitat in the Headwaters of South Tributary to Forty Mile Brook (Area R, Facing Upstream)

Caribou Lake is a 280,000 m^2 man-made lake that was created as fish habitat compensation under the *Fisheries Act* for the creation of the STTP tailings pond in the late 1980s. A diversion dam at the outlet of the lake separates it from the STTP tailings pond. Substrate in the lake consists of gravel and mud (GNB 2016). In-water cover is provided by woody debris (GNB 2016). Fish passage into the lake is provided through the existing Caribou Lake diversion channel (Figure 5.9).

The existing Caribou Lake diversion channel runs west of the STTP and forms the outlet of Caribou Lake. It is located outside of the influence of the Caribou mine effluent discharge and the historic mining legacies at the site (Stantec 2015a). The Caribou Lake diversion channel is a manmade channel which serves to divert Caribou Lake waters around the existing STTP and provides upstream fish passage into Caribou Lake. Gradient within the sampling area (Area D) for the channel is relatively low (1%) in its upstream portion, increasing downstream to between 5-7%. The habitat types within the diversion channel are flat and shallow run at Area D. Water depths are generally shallow ranging from 0.2 to 0.4 m during low flow conditions. Stream widths ranged from 4 to 8 m with substrates dominated by organics and fines, with small amounts of gravel and cobble. There are small amounts (10%) of woody debris throughout the watercourse and instream cover was provided by aquatic plants (submergent macrophytes). Stream side vegetation is dominated by shrubs and grasses (Stantec 2015a). Representative habitat is provided in Photo 2.

Photo 2 Representative Habitat in the Caribou Lake Diversion Channel (Area D, Facing Upstream)

An unnamed tributary to the south tributary to Forty Mile Brook is located directly downstream of the existing polishing pond (Area PPD) and is directly exposed to 100% mine effluent from the Caribou mine (Stantec 2015a). Its flow is regulated primarily by the STTP discharge, although natural seepage/precipitation as well as dam seepage waters provide flow. Area PPD consists of riffle, run, glide and debris jams habitats. Water depths ranged from 0.15 to 0.25 m. Stream widths ranged from 2.5 to 5.5 m with mixed substrate dominated by organic matter and also composed of small gravel, cobble, and boulder. There were large amounts of instream woody debris in the channel which provide habitat for fish. Stream side vegetation is dominated by shrubs and grasses, with a small number of conifers and deciduous trees (Stantec 2015a). Representative habitat is provided in Photo 3.

Photo 3 Representative Habitat Downstream of the Polishing Pond (Area PPD, Facing Downstream)

The lower portion of the south tributary to Forty Mile Brook (Area B and S) drains the diversion channel (Area D) and the unnamed tributary to Forty Mile brook (Area PPD) (Figure 5.9). The lower portion of the south tributary to Forty Mile Brook (Area B and S) is generally low gradient (1-2%) with a mix of riffle, flat, and run habitat (Stantec 2015a). Water depths range from 0.2 to 0.5 m at Area B. Stream widths ranged from 3 to 5.5 m with mixed substrate containing boulders, cobble, gravel, and sand. Stream side vegetation is dominated by shrubs and conifers (Stantec 2015a). Representative habitat for Area B is provided in Photo 4, and for Area S is provided in Photo 5.

Photo 4 Representative Habitat in the Lower Reach of the South Tributary to Forty Mile Brook (Area B, Facing Downstream)

Photo 5 Representative Habitat in the Lower Reach of South Tributary to Forty Mile Brook (Area S, Facing Upstream)

Water quality in the freshwater environment is typically characterized in terms of the ability to meet guideline values identified in the CCME “Canadian Environmental Quality Guidelines: Water Quality Guidelines for the Protection of Aquatic Life (Freshwater)” (CCME 1999a CCME FAL guidelines). The surface water dissolved oxygen (DO) concentration in south tributary to Forty Mile Brook (i.e., Area R, Area D, Area PPD, Area B, Area S) met the CCME FAL recommended minimum value of 9.5 mg/L for early life stages at two locations and exceeded the recommended minimum value of 6.5 mg/L for other life stages at all locations (Stantec 2018b; Stantec 2015a) (Table 5.12). The pH was within the CCME FAL recommended range of 6.5–9.0 on two sampling events at two locations and below the CCME recommended range in at least one sampling event at each location (Stantec 2018b; Stantec 2015a). Water quality in south tributary to Forty Mile Brook is generally suitable for cool and cold-water fish species, such as brook trout (Raleigh 1982).

Table 5.12 Range of In-Situ Water Quality Measurements from Watercourses in the Vicinity of Caribou Mine, September 2014 and 2017 (Taken from Stantec 2015a and 2018b)

Major Watercourse	Location	Dissolved Oxygen (mg/L)	Temperature (°C)	pH	Turbidity (NTU)	Conductivity (µS/cm)
North Tributary to Forty Mile Brook	Area J	9.7-10.2	12.7-17.2	5.5-6	3.9	260-309
South Tributary to Forty Mile Brook[1]	Area R - Unnamed Tributary to Forty Mile Brook	11.3	5.2	6.0	-	47
South Tributary to Forty Mile Brook	Area D - Caribou Lake Diversion Channel	9.3-9.4	13.7-17.0	6.3-7.03	2.29	20-21
South Tributary to Forty Mile Brook	Area PPD – Unnamed Tributary to Forty Mile Brook	8.9 - 10.2	12.2-15.1	6.0-6.97	-	465-1078
South Tributary to Forty Mile Brook	Area B	8.7-9.3	11.8-16.1	6.0-6.77	0.93	103-140
South Tributary to Forty Mile Brook[1]	Area S	9.7	12.5	6.2	-	260
Main Tributary to Forty Mile Brook	Area H	9.3-10.6	10.5-16.9	6.2-6.58	2.96	209-433
Main Tributary to Forty Mile Brook[2]	Area E	10.2	16.0	7.39	1.04	215
CCME Guidelines for the Protection of Aquatic Life (Freshwater) (CCME 1999a)	-	>6.5[3], >9.5[4]	NA	6.5-9.0	NA	NA

Note:
[1] In-situ water sampling only conducted in 2014 (Stantec 2015a)
[2] In-situ water sampling only conducted in 2017 (Stantec 2018b)
[3] CCME recommended minimum value for older life stages
[4] CCME recommended minimum value for early life stages
NA= Not Applicable
ND = no data

Metal concentrations in surface water for aluminum, arsenic, cadmium, copper, lead, nickel and zinc are below the CCME FAL guidelines in the south tributary to Forty Mile Brook at Area R and D (Stantec 2015a; Stantec 2018b). In the watercourse draining the existing polishing pond (Area PPD), metal concentrations exceed the CCME FAL guidelines for cadmium, copper, lead, and zinc. In the lower reach of the south tributary to Forty Mile Brook downstream of mine effluent discharge, metal concentrations in surface water exceed CCME FAL guidelines for cadmium, copper, lead, and zinc at Area B and S (Stantec 2018b; Stantec 2015a).

Metal concentrations in sediment for arsenic, cadmium, copper, lead and zinc are below the CCME's "Canadian Environmental Quality Guidelines: Sediment Quality Guidelines for the Protection of Aquatic Life (Freshwater)" (CCME 1999b, hereinafter referred to as the CCME sediment quality guidelines) in the south tributary to Forty Mile Brook at Area R and D (Stantec 2018b; Stantec 2015a). In the watercourse draining the existing polishing pond (Area PPD), metal concentrations exceed the CCME probable effects level (PEL) guidelines in sediment for arsenic, cadmium, copper, lead, and zinc. In the lower reach of south tributary toForty Mile Brook downstream of the mine effluent discharge, concentrations in sediment exceed CCME PEL guidelines in sediment for arsenic, lead, and zinc at Areas B and S (Stantec 2018b; Stantec 2015a).

The benthic invertebrate community in south tributary to Forty Mile Brook exhibits variability between areas (Stantec 2015a). The unnamed tributary upstream of Caribou Lake (Area R) has similar density (4,300 per m²) and taxon richness (25 taxon) as the diversion channel (Area D) (5,500 per m² and 24 taxon, respectively) and is represented by high proportions of Ephemeroptera (EPT), Plectoptera and Tricoptera (EPT) (~75%) and low proportions of Chironomids (~10%). Similarly, the benthic invertebrate community at Area D is characterized by high proportions of EPT (~55%) and low proportions of Chironomids (~10%). Area PPD, downstream of the existing STTP shows reduced diversity (1,800 per m²), taxon richness (16 taxon) compared to Area R, and is represented by lower proportions of EPT (~40%) and higher proportions of Chironomids (20%) (Stantec 2015a). Area B, the downstream most site in the south tributary toForty Mile Brook, shows reduced benthic invertebrate density (2,100 per m²) but similar taxonomic richness (7 taxon) in comparison to reference areas (i.e., Area R), and has a similar taxonomic composition to Area D (~60% EPT and ~15% Chironomids). Taxa within the benthic invertebrate community are generally indicative of good water quality, with notable mine effluent discharge effects on the community composition for a limited spatial extent at Area PPD – immediately downstream of the existing polishing pond discharge.

North Tributary to Forty Mile Brook

The fish habitat within north tributary to Forty Mile Brook differs based on its location relative to current historical legacies at the Caribou mine, and can be broken into three reaches which include the headwaters of the north tributary to Forty Mile Brook, G-Pond and Fire Pond, and the lower reach of the north tributary to Forty Mile Brook (Figure 5.9).

The watercourses in the headwaters of the north tributary to Forty Mile Brook upstream of the Fire Pond are between 1 and 2 m wide. Substrates vary and consist of organics, sand, gravel, cobble, and bedrock. Maximum water depths are 1 m deep. There is abundant cover provided by overhanging vegetation. There also is a natural waterfall about 150 m upstream from the confluence of the north and south tributaries, identified as barrier to upstream fish passage (Montreal Engineering 1980 in Jacques Whitford 2008).

Habitat within the areas of G-Pond and the Fire Pond is heavily influenced by the continued seepage from ARD due to the historical storage of waste rock along the banks of the north tributary to Forty Mile Brook, which has resulted in an absence of aquatic vegetation in this area. Substrate consisted of coarse gravel, angular stones, sandy clay, and silty mud in flowing areas, and fines in depositional areas (e.g., Fire Pond). The substrate was covered with a fine sediment (Jacques Whitford 2008). As the habitat upstream of the Fire Pond and associated upstream habitat has been heavily affected by human activities, fish passage is not required above the Fire Pond dam (Plante 2015).

Fish habitat in lower reach of the north tributary to Forty Mile Brook (Area J) upstream of the confluence with Forty Mile Brook has low gradient (1-2%) (Stantec 2015a). Stream width is <5 m width mixed substrate composed of boulders, cobble, gravel, and sand. Stream side vegetation is dominated by conifers, some deciduous and shrubs (Stantec 2015a). Representative habitat is provided in Photo 6.

Photo 6 Representative Habitat in the Lower Reach of the North Tributary to Forty Mile Brook (Area J, Facing Downstream)

Water chemistry in the north tributary to Forty Mile Brook is heavily-affected by the historic Anaconda tailings and ARD stockpiles (Stantec 2015a). The DO concentration in the north tributary to Forty Mile Brook (Area J) met the CCME recommended minimum value of 9.5 mg/L for early life stages (Stantec 2015a) (Table 5.12). The pH was below the CCME recommended range (6.5–9.0), and sufficiently low to assume that this is likely unsuitable for fish species such as brook trout (Raleigh 1982).

Water chemistry within the headwaters of the north tributary to Forty Mile Brook (50 m upstream of G Pond) is characterized by elevated concentrations of copper, lead, and zinc (Essalhi, A., pers. comm., 2018). Similarly, water chemistry in the lower portion of the north tributary to Forty Mile Brook is characterized by elevated concentrations of various trace metals including aluminum, cadmium, copper, nickel, and zinc relative to other locations in the area (Surface Water, Section 5.5; Stantec 2015a). Trace metal concentrations for aluminum, cadmium, copper, and zinc exceeded CCME FAL guidelines at Area J (Stantec 2015a).

No sediment metal concentrations were available for the headwaters of the north tributary to Forty Mile Brook or the area around G-Pond and the Fire Pond. Metal concentrations in sediment are elevated in the lower portions of the north tributary to Forty Mile Brook (Area J) relative to CCME PEL guidelines for sediment quality for arsenic, copper and zinc (Stantec 2015a).

The headwaters of the north tributary to Forty Mile Brook upstream of the Anaconda tailings show a healthy benthic community with mayflies well represented (Jacques Whitford 2008). At all other sites surveyed on the north tributary to Forty Mile Brook downstream, benthic invertebrate populations were virtually nonexistent (Jacques Whitford 2008).

Main Branch Forty Mile Brook Upstream of the Confluence with Caribou Brook

The confluence of the north and south tributaries to Forty Mile Brook is characterized by seepage containing metals coming from the historic Anaconda tailings area.

The habitat in the main branch of Forty Mile Brook approximately 1.5 km downstream of the confluence of the south and north tributaries (Area H) is relatively low gradient (2-3%). Fish habitat consists of riffle, pool, flat, and run habitat types. Water depth ranged from 0.2 to 0.7 m. Stream widths ranged from 5 to 9 m with mixed substrate composed of boulders, cobble, gravel, and sand. This habitat is characterized by the absence of aquatic vegetation, fish species, and benthic communities. Typically, the bottom at this location is covered with a “red and grey sludge precipitate” and has been deemed unproductive (R.A. Currie Ltd. 1988 in Jacques Whitford 2008). Representative habitat is provided in Photo 7.

Photo 7 Representative Habitat in the Main Branch of Forty Mile Brook Upstream of the Confluence with Caribou Brook (Area H, Facing Upstream)

Water quality measurements are presented in Table 5.12. The DO concentration in Forty Mile Brook met the CCME FAL recommended minimum value of 9.5 mg/L for early life stages at Area H and exceeded the recommended minimum value of 6.5 mg/L for other life stages at Area H for one sampling event (CCME 1999a). The pH was within the CCME FAL recommended range of 6.5–9.0 at Area H for one sampling event and below the CCME FAL recommended range for one sampling event. Dissolved oxygen, pH, and temperature in Forty Mile Brook are generally suitable for cool and cold-water fish species such as brook trout (Raleigh 1982).

Water chemistry in the main branch of Forty Mile Brook (Area H) is characterized by elevated concentrations of aluminum, cadmium, cobalt, copper, total suspended solids, nickel, and zinc relative to other locations in the area (Stantec 2015a). Trace metal concentrations for aluminum, cadmium, copper, and zinc exceeded CCME FAL guidelines (CCME 1999a) at Area H (Stantec 2015a; Stantec 2018b).

Trace metal concentrations in sediment are elevated the main branch of Forty Mile Brook (Area H) relative to CCME (1999b) PEL guidelines for sediment quality for arsenic, cadmium, copper, lead, nickel and zinc (Stantec 2015a).

Forty Mile Brook below the confluence (Area H) has very low density (39 per m^2) and taxon richness (5 taxon) compared to the other watercourses in the area (Stantec 2015a). The benthic invertebrate community is represented by high proportions of Other (e.g., Acarina, Dytiscidae, Pyralidae) (45%), and roughly equal portions of EPT (25%), Dipterans (20%), and Chironomids (15%) (Stantec 2015a).

Main Branch Forty Mile Brook Downstream of the Confluence with Caribou Brook

The fish habitat within the main branch of Forty Mile Brook downstream of the confluence with Caribou Brook can be broken into three major reaches which include an upper reach for approximately 12 km downstream of the confluence with Caribou Brook, a middle reach for approximately 2.5 km, and a lower reach for approximately 20 km downstream to the confluence with Nepisiguit River.

The habitat within the upper reach of the main branch of Forty Mile Brook downstream of the confluence with Caribou Brook is characterized from aerial imagery as flowing water habitat (e.g., riffle, run and pool) for approximately 12 km downstream of the confluence with Caribou Brook. Stream widths generally ranged from 5 to 10 m. No detailed fish habitat information was available.

The habitat within the middle reach of Forty Mile Brook changes for approximately 2.5 km to slower flowing habitat with widths of 10 to 80 m. No detailed fish habitat information was available.

The habitat in the lower reach of Forty Mile Brook is characterized from aerial imagery as flowing water habitat (e.g., riffle, run and pool) for approximately 20 km downstream to the confluence with the Nepisiguit River. Stream widths generally ranged from 10 to 20 m.

The habitat in the lower reach of the main branch of Forty Mile Brook approximately 300 m upstream of the confluence with the Nepisiguit River (Area E) is characterized by riffle habitat (Stantec 2018b). Stream width ranged from 7 to 8 m with water depths averaging 0.3 m and a maximum of 0.75 m. Riparian vegetation was dominated by trees (predominantly conifers), with some shrubs and grass. The majority of substrate was cobble, with smaller quantities of gravel and boulder. Banks were generally stable (Stantec 2018b). Representative habitat is provided in Photo 8.

Photo 8 Representative Habitat in the Main Branch of Forty Mile Brook Downstream of the Confluence with Caribou Brook (Area E Facing Downstream)

Water quality measurements are presented in Table 5.12. The DO concentration in Forty Mile Brook met the CCME recommended minimum value of 9.5 mg/L for early life stages at Area E (Stantec 2018b; CCME 1999a). The pH was within the CCME recommended range of 6.5–9.0. Dissolved oxygen, pH and temperature in main branch Forty Mile Brook is generally suitable for cool and cold-water fish species, such as brook trout (Raleigh 1982). No information was available for *in-situ* water quality for the upper or middle reach.

Trace metal concentrations of surface water in Forty Mile Brook upstream of the confluence with the Nepisiguit River (Area E) are generaly similar to upstream reference areas (i.e., Area R) on the south tributary to Forty Mile Brook (Surface Water; Section 5.5.2; Stantec 2018b). Trace metal concentrations of cadmium, copper, and zinc in surface water exceeded CCME FAL guidelines (CCME 1999a) at Area E (Stantec 2018b). No information was available for trace metal concentrations in surface water for the upper or middle reach.

Trace metal concentrations in sediment are elevated at Area E for arsenic and zinc relative to CCME (1999b) PEL guidelines (Stantec 2018b). No information was available on trace metal concentrations in sediment for the upper or middle reach.

There is no benthic invertebrate community data available within the upper or middle reach. The habitat in the lower reach of the main branch of Forty Mile Brook approximately 300 m upstream of the confluence with the Nepisiguit River (Area E) has lower density (3,198 per m^2), but similar richness, evenness, and diversity compared to Forty Four Mile Brook, a nearby watercourse of similar size and habitat (Stantec 2018b). The benthic invertebrate community at Area E is represented by high proportions of EPT (75%) and Chironomids (20%) (Stantec 2018b).

5.6.2.3 Fish Populations

The Nepisiguit River has over twenty fish species (GNB 2017; Stantec 2013; Carr 2006; Courtney et al. 2002; Scott and Crossman 1978) including a number of diadromous species present downstream of the Nepisiguit Falls, including Atlantic salmon (*Salmo salar*) and American eel (*Anguilla rostrata*) (Nepisiguit Salmon Association 2011-2017).

Nepisiguit Falls presents a natural barrier to fish passage and no anadromous species are found upstream of the falls. The Nepisiguit Falls Generating Station (NFGS) operated by NB Power sits at the top of Nepisiguit Falls. The fish community upstream of Nepisiguit Falls consists of brook trout (*Salvelinus fontinalis*), blacknose dace (*Rhinichthys atratulus*), brook stickleback (*Culaea inconstans*), common shiner (*Luxilus cornutus*), creek chub (*Semotilus atromaculatus*), lake chub (*Couesius plumbeus*), northern redbelly dace (*Chrosomus eos*), nine-spine stickleback (*Pungitius pungitius*), pearl dace (*Margariscus margarita*), slimy sculpin (*Cottus cognatus*), three-spine stickleback (*Gasterosteus aculeatus*) and white sucker (*Catostomus commersonii*) and occasionally American eel (Stantec 2018b; Connell, C., pers. Comm., 2017; Stantec 2015a; Stantec 2013; Stantec 2011). American eel is unique in that they can ascend wetted vertical surfaces (Legault 1988) and are occasionally found upstream of the NFGS (Nepisiguit Salmon Association 2011-2017; Stantec 2013).

Brook trout, blacknose dace, slimy sculpin, white sucker, nine-spine stickleback, finescale dace and a chub *spp*. Have been observed in the watercourses near the Caribou mine based on electrofishing surveys (Stantec 2018b; Stantec 2015a; Stantec 2013; R.A. Currie Ltd. 1987 and Washburn and Gillis 1997 in Jacques Whiteford 2008). The dominant fish species in the area is brook trout. A recreational Crown reserve fishery for brook trout occurs annually in Caribou Lake (GNB 2016). Blacknose dace are also present in Caribou Lake (Gagnon, L., pers. Comm., 2018). Fish are known to be present in the south tributary to Forty Mile Brook (Areas R, D, PPD, and B) and are present in the headwaters of the north tributary to Forty Mile Brook (R.A. Currie Ltd. 1987 in Jacques Whitford 2008). No fish are known to be present in the lower reach of the north tributary to Forty Mile Brook (Area J) or in the main branch of Forty Mile Brook downstream of the influence of the Anaconda tailings (Area H) (Stantec 2015a). Fish are present within Forty Mile Brook upstream of the confluence with the Nepisiguit River (Area E; Stantec 2018b).

The abundance of fish in the south tributary to Forty Mile Brook exhibits variability between areas (Table 5.13 Stantec 2018b; Stantec 2015a). Areas upstream of the influence of the mine (e.g., Areas R and D) tend to have higher abundance of fish compared to areas downstream of the mine (Areas PPD, H and E). The lowest abundance of fish is found downstream of the final discharge point of the Mine (Area PPD), with no fish observed at Area H downstream from the confluence on the main branch Forty Mile Brook below the historical Anaconda Tailings (Area H) and a moderate abundance of fish in Forty Mile Brook upstream of the confluence with the Nepisiguit River Stantec (Stantec 2018b; Stantec 2015a).

The abundance of brook trout in Caribou Lake based on catch rate, between 1994 to 1997, and 2006 to 2007 ranges from 16 to 62 fish per rod day and is higher than other Crown reserve angling lakes in the Nepisiguit River watershed (range of 8 to 40 fish per rod day) between 2006 to 2007 (NBDNR no date).

Table 5.13 Presence and Abundance of Fish Species Near Caribou mine Collected by Electrofishing (Taken From Stantec 2015a and Stantec 2018b)

Year	Area	Species Caught	Catch Per Unit Effort (# fish/10,000 seconds)
2014	R	Brook trout, blacknose dace	1,097
2017	D	Brook trout, blacknose dace	998
2014	PPD	Brook trout, blacknose dace	204
2014	H	NA	0
2017	E	Brook trout, blacknose dace, slimy sculpin	480
Note: NA = Not Applicable			

5.6.2.4 Aquatic Species At Risk and Species of Conservation Concern

American eel is the only SAR/SOCC known to be present upstream of Nepisiguit Falls which has the potential to occur within the LAA (Nepisiguit Salmon Association 2011-2017, Stantec 2013). American eel is listed as *threatened* under COSEWIC and NB *SARA* but it is not legally protected under *SARA*. This species spends most of its life in freshwater, migrating to the ocean to spawn and die in the Sargasso Sea. The spawning migration occurs in the fall, and elvers arrive in estuaries in spring and early summer (Scott and Crossman 1973). There is no designated fish passage for American eel at the NFGS as Nepisiguit Falls present a natural barrier. While American eel occasionally ascend above the NFGS, likely by scaling wetted surfaces of the dam or rocks, it is expected that the falls prevents most eels from accessing fish habitat above the falls. Therefore, fish habitat above the falls is not considered to be utilized by American eel at the population level.

5.6.3 Potential Project Interactions with Fish and Fish Habitat

This section describes how the Project could interact with fish populations and fish habitat during construction, operation, and closure/post-closure. Further, mitigative measures that will be applied to limit the potential effects of these interactions are presented.

As will be discussed in the subsections that follow, the Project will interact with fish and fish habitat in the following ways:

- Construction of the new TMF including the TMF dams, polishing pond, polishing pond dam, and area to be flooded will result in the permanent loss of fish habitat due to the covering of portions of the north tributary to Forty Mile Brook, the south tributary to Forty Mile Brook and parts of the main branch of Forty Mile Brook upstream of the confluence with Caribou Brook by the TMF and polishing pond.
- Construction of the new TMF including the TMF dams, polishing pond, polishing pond dam have the potential to result in a change in fish habitat or fish populations through construction activities (e.g., sedimentation, introduction of deleterious materials, equipment working near or in watercourses).
- Construction activities associated with the TMF and polishing pond may result in temporary release of contaminants including suspended solids to receiving waters (mitigated through the use of erosion and sedimentation controls).
- Flooding of organic soils within the TMF and polishing pond may result in potential sources of methylmercury.
- Construction activities associated with the TMF and polishing pond may result in changes to habitat connectivity through the impediment of fish passage resulting from the physical footprint of the dam.

- Operation of the new TMF will require the release of treated effluent to Forty Mile Brook (as is currently the case with the STTP), which may contribute residual concentrations of trace metals to Forty Mile Brook downstream of the Project.
- Sequestration of acid rock drainage arising from historical tailings at the Caribou site is expected to result in an overall improvement in downstream water quality in Forty Mile Brook over time, thereby potentially restoring water quality in parts of Forty Mile Brook that may be conducive to an eventual return of fish populations in the main branch Forty Mile Brook Upstream of the Confluence with Caribou where fish are not currently present. Corresponding improvements to the benthic invertebrate community, fish productivity and fish populations as a result of improvements in fish habitat (i.e., water quality) downstream of the Project are anticipated as a result.
- It is anticipated that water temperatures downstream of the proposed polishing pond dam will increase and DO concentrations will decrease as a result of the increased surface area available for warming in the TMF during operation and into closure.

5.6.3.1 Construction Phase

Construction is anticipated to include a variety of activities that could result in interactions with, or changes to, fish populations and fish habitat within the vicinity of the Caribou mine. These activities include but are not limited to site preparation; construction of the cofferdam, Stage 1 TMF dam, and polishing pond and dam; and access road construction.

The timing of construction has the potential to result in a change in fish habitat and fish populations. Conducting in-stream construction work during periods of increased discharge can increase the potential for run-off and sedimentation events into watercourses and affect fish and fish habitat. Conducting in-stream work when sensitive life stages of fish are present (e.g., spawning) also has the potential to result in changes to fish populations. In-water work will be minimized and timed between June 1 and September 30 unless authorized, to correspond with the summer low-flow period and outside of sensitive periods for early life stages of fish. According to DFO (2016), this timing window will reduce the risk of harm to fish and fish habitat. Additionally, once the cofferdam is constructed, best efforts will be made to capture fish located upstream of the cofferdam and to relocate them further downstream, so that undue mortality does not occur. Therefore, although some mortality is possible, adverse interactions with fish at the population level are not expected.

A potential interaction between fish habitat may result from the operation of heavy machinery (e.g., excavators, loaders) within 30 m of a watercourse during construction activities will be subject to a watercourse and wetland alteration (WAWA) permit. A change in fish habitat could result from alterations to riparian habitats, which may reduce bank stability and lead to short-term changes in soil erosion and sedimentation in Forty Mile Brook. Increased soil erosion and sedimentation could negatively affect fish populations and fish habitat through increases in embeddedness, increased turbidity and total suspended solids; behavioural changes in fish; and smothering benthic invertebrate communities and/or early life stages of fish (DFO 2014; DFO 2013b). The potential interactions related to soil erosion and sedimentation are expected to be minimized through standard mitigation measures (DFO 2016; Surface Water Section 5.5) and adherence to the WAWA permit conditions. Therefore, substantive interactions between construction and fish habitat as a result of soil erosion and sedimentation are not expected.

A change in fish habitat could result from the introduction of deleterious substances (e.g., grease, fuel) into watercourses through machinery contact with water during construction. The introduction of deleterious substances could affect the health of fish (e.g., sublethal effects) or result in direct mortality depending on the quantity and type of the substance. The potential interactions related to the introduction of deleterious substances will be minimized through refueling, servicing, and storing equipment beyond 30 m of a watercourse, keeping machinery clean, and having a spill response plan in place. Substantive interactions between construction and fish habitat as a result of the introduction of deleterious substances are therefore not expected.

Construction activities are anticipated to result in short-term temporary changes in stream flow, resulting in a temporary change in fish habitat downstream of the mine. To complete the construction of the cofferdam in the dry, it will be necessary to isolate the work site from the watercourse. Prior to installing the cofferdam, the Fire Pond and STTP water levels will be lowered to their lowest operating level so that each basin can be used to maximize water storage during the construction period. During this time, it is anticipated that the quantity of fish habitat in Forty Mile Brook may be temporarily reduced and that the quality of the habitat (e.g., water quality) may be reduced. These changes in the quality and quantity of fish habitat could result in a change in fish populations. However, since fish are not present or the abundance of fish in Forty Mile Brook is low, these short-term changes in habitat quality and quantity are not anticipated to result in population-level effects.

Equipment entering a watercourse for in-water works or stranding associated with the release of water in the Fire Pond and STTP to provide capacity during rainfall events during construction could result in the direct mortality or injury to fish through physical contact or stranding. The potential interactions related to fish mortality or injury can be reduced through standard mitigation measures, which will include fish rescue activities (on a best effort basis) within the areas of in-water works or water level drawdown (e.g., upstream of the cofferdam).

During the construction of the in-water works (e.g., cofferdam, TMF, polishing pond) and the subsequent flooding of Forty Mile Brook to create the TMF during Stage 1, it is anticipated that the Project will directly interact with fish habitat. During Stage 1, a permanent alteration to riparian and in-stream habitat will occur as a result of site preparation, the construction of the cofferdam, Stage 1TMF dam and polishing pond dam, the flooding of Forty Mile Brook to create the TMF, and the subsequent deposition of tailings and sequestration of mine contact water within the TMF (Figure 2.3). During construction of the TMF, a cofferdam will be used to isolate the in-water work area upstream of the proposed TMF and polishing pond to facilitate working in the dry. Construction of the cofferdam will require the temporary placement of the structure in the stream bed. As described previously, water flow from Forty Mile Brook will be managed through the Fire Pond and STTP and any additional flow will be diverted around the cofferdam to facilitate working in the dry. Following the construction of the TMF and polishing pond dams, the cofferdam will be removed, and the areas will be allowed to flood to create the TMF and polishing pond. The permanent alteration of fish habitat caused by the construction and ongoing presence of the new TMF may result in serious harm to fish as defined by the *Fisheries Act*, which will require an authorization under Section 35(2) of the *Fisheries Act* (with appropriate offsetting for residual effects on fish and fish habitat) as well as a regulatory amendment to the MDMER to add the portion of Forty Mile Brook that will be covered by the new TMF to Schedule 2 of that regulation. It is anticipated that Stage 1 of the Project will result in the direct loss of approximately 13,000 m^2 of riverine habitat.

During Stage 1, the area where serious harm is anticipated to occur is located in the lower reach of the north tributary to Forty Mile Brook, the lower reach of the south tributary to Forty Mile Brook and a small portion of the main branch of Forty Mile Brook. The lower reach of the north and south tributaries to Forty Mile Brook and the main branch of Forty Mile Brook are generally not suitable for fish as a result of impaired water quality from historical tailings and waste rock. Where fish are present in the lower reaches of the south tributary to Forty Mile Brook abundance is generally low. As such, it is anticipated that the loss of this habitat will not affect fish at the population level. In fact, given that the Project (once in operation) will result in an improvement in water quality in over time, it is expected that the Project itself may form a portion or all of the offsetting requirement for serious harm as part of the *Fisheries Act* authorization process (i.e., the Project is at least partially, but may be wholly, self-offsetting). This will be discussed with DFO as part of the *Fisheries Act* authorization process, following the EIA review.

Construction activities for the new TMF and closure dam are anticipated to result in potential changes in the natural stream flow (i.e., water quantity) in Forty Mile Brook through the construction of the NTTP. As part of the TMF (Stage 1) construction, the lower portion of the existing Caribou Lake diversion channel will be flooded. Water from the existing diversion channel will be flowing into the NTTP.

Construction activities for the new TMF is anticipated to result in permanent changes to habitat connectivity and fish passage in the south tributary to Forty Mile Brook through the physical placement of the TMF dam and polishing pond dam and flooding of the lower portion of the existing Caribou Lake diversion channel which facilitates fish passage into Caribou Lake. Following the commencement of construction activities, fish passage will not be facilitated upstream of the proposed polishing pond dam location as a result of the inherent technical difficulties in providing fish passage from the proposed polishing pond dam location on Forty Mile Brook to Caribou Lake and upstream of the northwestern extent of the TMF on the north tributary to Forty Mile Brook (Figure 2.3). Although current infrastructure allows for fish passage between Caribou Lake/diversion channel and the Forty Mile Brook system, historical ARD runoff has resulted in degraded water quality (Stantec 2018b), thus likely detering fish passage. As such, the proposed configuration of the NTTP is not expected to substantively change fish migration patterns within the south tributary to Forty Mile Brook. Since the Fire Pond Dam is likely a fish passage barrier, fish migration patterns in the north tributary to Forty Mile Brook will remain similar to existing conditions. The potential for Offsetting as a result to changes in habitat connectivity will be discussed with DFO as part of the *Fisheries Act* authorization process, following the EIA review.

Construction activities for the new TMF have the potential to result in short-term resuspension of contaminants within the water column (i.e., trace metals) through the disruption of stream sediments arising from construction activities. In Stage 1, the construction of the TMF will require the stream bed to be excavated to bedrock in order to secure the TMF dam. It is anticipated that the excavation will take place in the dry; however, it is possible that small amounts of sediment may be released through surface water run-off into Forty Mile Brook. As the quantity of water run-off is anticipated to be low, the potential interactions resulting from the redistribution of contaminants is expected to be minimized through standard mitigation measures (e.g., erosion control) (DFO 2016; Surface Water Section 5.5). Therefore, substantive interactions between construction and fish and fish habitat as a result of resuspension of contaminants are not expected.

Increases in water level during the construction of the TMF in Stage 1 could increase levels of methylmercury in surface water as a result of bacterial decomposition of flooded organic matter contained in surface soils (CCME 2003). Typically, methylmercury represents less than 10% of the total mercury available in surface water. In newly formed reservoirs, it can exceed 30% (CCME 2003). The rate of methylmercury production is influenced by several factors including the concentration and availability of mercury, composition of the microbial community, substrate, pH, temperature, dissolved and particulate organic matter, iron, and sulphate. Bacterial activity increases with increasing temperature and biodegradable organic carbon. Therefore, methylation rates are highest in surface sediments with freshly deposited organic matter. As a result, there is an increase in the amount of available methylmercury in newly formed reservoirs, which decreases over time (e.g., more than a decade) (Hall et al. 2005; St. Louis et al. 2004).

Methylmercury is easily absorbed by aquatic organisms and becomes concentrated further up the aquatic food web (CCME 2003). The highest methylmercury concentrations occur in large, older predatory fish as it is accumulated in fish almost exclusively by diet (CCME 2003). The Project has the potential to result in increases in methylmercury concentrations in surface water, benthic invertebrate communities, and fish. The bioaccumulation of methylmercury in fish tissues could result in a change in fish populations as a result of changes in growth, reproduction, development and mortality (CCME 2003). Clearing and removing debris within the flooded area of the TMF during Stage 1 will minimize organic material available for bacterial decomposition. Additionally, the deposition of tailings over remaining organic material in the flooded area will further reduce the availability of organic matter. The EEM program that will be implemented in compliance with the MDMER will confirm whether these effects are occurring, prompting adaptive management in the event that methylmercury in fish becomes a serious concern.

5.6.3.2 Operation Phase

Any interactions associated with the existing mine processing (e.g., effluent discharge, tailings management) are anticipated to be similar to existing conditions and are not discussed below. The focus of the discussion that follows is solely on the operation of the new TMF and related facilities to be constructed as part of the Project.

It is anticipated that there will be a generally positive change in water quality in Forty Mile Brook resulting from the operation of the NTTP dam, over time. Water quality is strongly linked to fish habitat quality and can provide a pathway for metal uptake in fish. It is anticipated that elevated trace metal concentrations in surface water will decrease as a result of sequestration of historical tailings into the new TMF and the associated water treatment processes within the NTTP/polishing pond prior to discharge into Forty Mile Brook as per provincial and federal requirements. As a result, with these historical sources of ARD and metal leaching having been sequestered, trace metal concentrations in surface water downstream of the new TMF are anticipated to be equivalent or improve relative to existing conditions and potentially improve fish habitat in Forty Mile Brook. This will be confirmed as part of the EEM program and routine monitoring for surface water quality downstream of the TMF, as a follow-up measure.

Similar to water quality, it is anticipated that a change in sediment quality may result from the Project. Sediment quality affects fish habitat quality as well as potential uptake of metals through food sources for fish (e.g., benthic invertebrates). It is anticipated that the Project will result in improved concentrations of currently elevated trace metals in sediment over the longer-term as a result of improved water quality from sequestration of historical tailings into the Forty Mile tailings area and the associated water treatment processes within the TMF and polishing pond prior to discharge. However, such improvement will be expected to occur over the longer term given the nature of water-to-sediment exchange of contaminants. This improvement will also be confirmed as part of the EEM program.

During operation, it is anticipated that water temperatures downstream of the new polishing pond dam will increase slightly as a result of the Project as a result of the increased surface area available for warming in the TMF during both Stage 1 and 2 of the Project (i.e., water impoundments tend to result in warmer surface water temperatures than flowing watercourses). Increased water temperatures have the potential to result in a change fish habitat which could result in a change in fish populations immediately downstream of where water is being impounded. Based upon surface water temperature modelling that was conducted for another project of a larger scale, it is anticipated that the temperature change downstream of the Project will be less than 2°C (Stantec 2015b), but on a watershed basis will not be distinguishable from current temperatures as this effect likely also exists with the existing STTP. As Forty Mile Brook is swiftly flowing and turbulent, the anticipated change is expected to be negligible and not result in a change in fish habitat or fish populations. Sufficient data do not currently exist to predict the magnitude and extent of the water temperature change. Project-specific modeling will be conducted at later stages of the Project development, under the Conceptual Water Management Plan.

Fish habitat in Forty Mile Brook may be affected by changes in dissolved oxygen concentrations. The solubility of oxygen decreases as water temperature increases (Tromans 1998), and as a result, dissolved oxygen concentrations in Forty Mile Brook, immediately downstream of the Project, may be slightly affected by the predicted increases in water temperature. These changes have the potential to result in a change fish habitat which could result in a change in fish populations immediately downstream of where water is being impounded, but as with temperature changes discussed above, DO changes on a watershed basis will not be distinguishable from current temperatures as this effect likely also exists with the existing STTP. Based on surface water temperature modelling that was conducted for another project of a larger scale, it is anticipated that the change in dissolved oxygen will be less than 0.24 mg/L compared to the baseline condition, which was considered negligible (Stantec 2015b). As Forty Mile Brook is swiftly flowing and turbulent, the anticipated change is expected to be negligible and not result in a change in fish habitat or fish populations. Sufficient data do not currently exist to predict the magnitude and extent of the dissolved oxygen change, which will be addressed in the Conceptual Water Management Plan.

During operation, it is anticipated that there may be a change in the natural surface water flow patterns as a result of the Project. Following the construction of the TMF, flow patterns in Forty Mile Brook have the potential to become more regulated as flow to Forty Mile Brook immediately downstream of the Project will be controlled through the TMF. Surface water quantity from a portion of the South Branch and North Branch Forty Mile Brook are already managed to some extent (i.e., through the existing STTP and Fire Pond). Therefore, the potential change is anticipated to be similar to existing conditions, with minimum flow requirements outlined in the Approval to Operate. This will be discussed in more detail in the Conceptual Water Management Plan.

During operation, it is anticipated that there will be positive changes to the benthic invertebrate community as a result of changes in fish habitat (i.e., water quality) downstream of the Project. Currently, the benthic invertebrate community is affected by the influences of ARD and metal leaching from the historical Anaconda tailings and waste rock upstream of the confluence of Forty Mile Brook and Caribou Brook (Stantec 2015a) as inferred through reduced density, taxon richness, and community composition. Improvements in fish habitat (i.e. water and sediment quality) are anticipated to result in improvements to the benthic invertebrate community. During operation, the benthic invertebrate community will be monitored during routine EEM as required by the MDMER.

Similar to the benthic invertebrate community, it is anticipated that there will be positive changes to fish productivity and fish populations downstream of the Project during operation as a result of changes in fish habitat and benthic invertebrate communities (i.e., fish food). Currently productivity and fish populations are limited downstream of the historical Anaconda tailings and waste rock as a result of poor quality habitat resulting from poor water quality due to ARD and metal leaching (Stantec 2015a; Jacques Whitford 2008), which in some cases is so poor that it does not support fish. Improvements to fish habitat (i.e., water) downstream of the Project may result in the presence of fish populations in areas that were formerly not inhabited because unsuitable habitat conditions existed and result in increased fish populations in areas which are currently fish-bearing through improved habitat quality. Improvements in the benthic invertebrate community (i.e., increased food) and fish populations are anticipated to result in improvements in fisheries productivity. During operation, the fish community will be monitored as part of EEM as required by the MDMER.

As described in construction, water flows from Caribou Lake and the existing diversion channel are proposed to flow into the new TMF. Fish have the potential to move into the NTTP, which may result in fish mortality as a result of poor water quality. Fish passage into the TMF from these areas will be prevented using fish screens to reduce fish mortality associated with their movements.

5.6.3.3 Closure/Post-Closure Phase

The effects of the Closure/Post-Closure phase of the Project on fish and fish habitat, which consists of the construction of the Stage 2 NTTP dam and new access road crossing(s), operation of the Stage 2 NTTP, and post-closure of the Caribou mine are described below.

Construction – Stage 2

The construction activities associated with the Stage 2 NTTP dam and access road crossing(s) are anticipated to be similar to those described in the construction phase of Stage 1 of the Project and effects on fish and fish habitat can be mitigated through standard mitigation.

During the construction of the in-water works (e.g., closure dam, road crossings) and the subsequent flooding of Forty Mile Brook to expand the NTTP during Stage 2, it is anticipated that the Project will directly interact with fish habitat. Stage 2, the closure dam, will be constructed over the existing tailings dam to increase the width and height of the dam in preparation for closure. The presence of the polishing pond downstream of the closure dam will further mitigate the potential for suspended sediments during construction, as water flow will be controlled through the final discharge point and subject to the Approval to Operate and the MDMER which place limits on total suspended solids.

During the construction of the in-water works (e.g., closure dam, road crossings) and the subsequent flooding of Forty Mile Brook to expand the NTTP during Stage 2, it is anticipated that the Project will directly interact with fish habitat. During Stage 2, a permanent alteration to riparian and in-stream habitat will occur as a result of further flooding within the upstream portion of the Forty Mile Brook watershed during construction of the Stage 2 TMF (Figure 2.5). As a result of the current Fire Pond Dam, there is currently no fish passage to the unnamed tributaries located upstream of the Fire Pond, and while some fish are present in these unnamed tributaries (and will likely continue to be present with the implementation of the Project), flooded habitat located upstream of the Fire Pond Dam is conservatively assumed to be lost as a result of Stage 2 of the Project. The permanent alteration of fish habitat caused by the construction and ongoing presence of the Stage 2 TMF and upstream habitat in the unnamed tributaries upstream of the Fire Pond may result in serious harm to fish as defined by the *Fisheries Act*, which will require an authorization under Section 35(2) of the *Fisheries Act* (with appropriate offsetting for residual effects on fish and fish habitat) as well as a regulatory amendment to the MDMER to add the portion of Forty Mile Brook that will be covered by the new TMF to Schedule 2 of that regulation. It is anticipated that Stage 2 of the Project will result in the additional loss of approximately 46,000 m² of fish habitat compared to Stage 1.

During Stage 2, the area where serious harm is anticipated to occur is located in small first and second order tributaries in the headwaters of the north tributary to Forty Mile Brook and the Fire Pond. Headwater habitat such as those in the north tributary to Forty Mile Brook are generally less productive than larger order streams (Calow 2009). The Fire Pond and its associated upstream habitat is considered to be marginal and heavily affected by human activities (Plante 2015) and generally not suitable for fish as a result of water quality impacts from ARD waste rock. As such, it is anticipated that the loss of this habitat will not affect fish at the population level.

Increases in water level during the construction of the TMF in Stage 2 could increase levels of methylmercury in surface water which could result in an increase in methylmercury concentrations in fish which could result in a change in fish populations, as described above for Stage 1. Adverse effects of methylmercury could include reduced growth, impaired reproduction and development, and/or mortality (CCME 2003). As mercury concentrations in the Caribou mine effluent are very low (<0.1 µg/L) and mercury is not used during processing, effluent as a potential source of additional mercury for methylation is not anticipated. Clearing, selling of merchantable timber, and removing as much debris as possible within the flooded area of the TMF during Stage 2 will assist in mitigating the production of methylmercury through the removal of organic material available for methylation. The PDA is relatively small and contains a relatively low proportion of wetlands (41% for Stage 1, 20% for Stage 2) which tend to contain higher levels of methylmercury (CCME 2003). For these reasons, methylmercury concentrations are not expected to exceed levels that may affect fish populations at the population level. Total mercury in effluent will be monitored as part of MDMER and, if mercury concentrations exceed 0.1 µg/L, a study on fish tissue will be conducted as part of the EEM program to be conducted as part of MDMER.

Operation – Stage 2

As described previously for Stage 1, any interactions associated with the existing mine processing (e.g., effluent discharge, tailings management) are anticipated to be similar to existing conditions and are not discussed below. The focus of the discussion that follows is solely on the operation of the new expanded TMF and related facilities to be constructed as part of the Project.

As described previously for Stage 1, it is anticipated that water temperatures downstream of the proposed polishing pond dam will further increase and dissolved oxygen concentrations may further decrease as a result of the increased surface area available for warming in the Stage 2 TMF (i.e., water impoundments tend to result in warmer surface water temperatures than flowing watercourses). Increased water temperatures have the potential to result in a change fish habitat which could result in a change in fish populations, but as with operation, water temperature changes will be limited to the immediate area downstream of the NTTP and polishing pond, and effects will be non-measurable on a watershed level. Sufficient data do not currently exist to predict the magnitude and extent of the water temperature change and this effect will be predicted and addressed in the Conceptual Water Management Plan.

In Stage 2, fish migration patterns are anticipated to be similar to Stage 1, although additional area above the Fire Pond will be flooded and no longer available to fish. As is currently the case, it is anticipated that fish will avoid areas as a result of poor water quality and will remain within the headwater tributaries above the Stage 2 TMF.

The environmental effects of the Project during closure/post-closure on water quality, sediment quality, benthic invertebrate communities, fish populations, and fish communities are likely to be similar to those described in Stage 1 Operation.

Closure and Post-Closure

During closure and post-closure, the environmental effects of the Project on water quantity are likely to be similar to Stage 1 and 2 operation. If the NTTP water quality does not require further water treatment to meet regulatory requirements, water discharge will be engineered so that minimum operational inputs are required. This could take the form of an engineered water conveyance outlet structure where the TMF water will be allowed to naturally discharge into the receiver via gravity. Under this scenario, surface water quantity may mimic the natural surface water quantities prior to mine development.

During post-closure, the environmental effects of the Project on water quality, sediment quality, benthic invertebrate communities, fish populations, and fish communities are likely to be similar to those described in Stage 1 Operation.

5.6.3.4 Mitigation for Fish and Fish Habitat

The potential interactions of the Project with fish populations and fish habitat will be mitigated by applying best management practices (BMPs) during construction, operation, and closure/post-closure (DFO 2016). TMNBL will obtain a WAWA permit, administered through NBDELG, for any in-water works or work within 30 m of a watercourse, and will comply with its conditions. DFO will be consulted to develop offsetting as appropriate, with consideration of the “Fisheries Productivity Investment Policy: A Proponent’s Guide to Offsetting” (DFO 2013b).

The key mitigative measures that will be applied to protect fish populations and fish habitat are provided in Table 5.14 These proposed mitigative measures will be developed further in updates to the TSSEMP. The TSSEMP will include general construction best management practices, spill management procedures, and erosion and sediment control procedures. All employees and contractors working on the Project will be trained on the TSSEMP prior to starting work.

Table 5.14 Key Mitigation for Fish Populations and Fish Habitat

Potential Interactions	Proposed Mitigation Measures
Habitat Quality/Fish Mortality	Any in-water and or work below the high-water mark will be conducted between June 1 and September 30, unless otherwise permitted through consultation with NBDELG and/or DFO. Every reasonable effort will be made to reduce the duration of instream works.
Habitat Quality/Fish Mortality	Effective erosion and sediment control measures will be installed prior to starting work to prevent sediment or contaminants from entering any watercourses, and inspected regularly. Turbidity curtains or silt fences will be installed at the cofferdam location. Any waste material will be stabilized or contained. Control structures will be inspected and maintained over the course of the construction until the disturbed area has stabilized, and natural revegetation has occurred. Non-biodegradable materials will be removed.
Habitat Quality/Fish Mortality	In-water worksites will be isolated from flowing water (i.e., by using a cofferdam) to contain or reduce suspended sediment where possible. Clean, low permeability material and rockfill will be used to construct the cofferdam, TMF and polishing pond. When possible, operate machinery above the high-water mark or inside of isolated areas
Fish Mortality	Prior to construction, best efforts will be made by a qualified environmental professional to relocate fish from within areas of in-water works or areas of water drawdown to an appropriate location in the same waters.
Habitat Quality, Fish Mortality	All fuels and lubricants used during construction will be stored according to regulated containment methods in designated areas
Habitat Quality, Fish Mortality	Refueling, servicing, and equipment storage will take place beyond 30 m of the watercourse to reduce the likelihood that deleterious substances will enter watercourses. An emergency spill response kit will be kept on-site during construction
Habitat Quality, Fish Mortality	Temporary storage of waste materials on-site will be located at least 30 m from watercourse.

Table 5.14 Key Mitigation for Fish Populations and Fish Habitat

Potential Interactions	Proposed Mitigation Measures
Habitat Quality	Maintain sufficient water over tailings within the TMF to prevent metal leaching and acid rock drainage, as described in the Approval to Operate
Habitat Quality	Treat water released from Project following closure, as required to meet the conditions of the Approval to Operate.
Habitat Quality, Habitat Quantity	Minimum flows will be maintained as described in the Approval to Operate in consideration of the Conceptual Water Management Plan
Fish Mortality	Fish screens and/or other barriers will be installed/maintained to prevent fish from migrating into the NTTP.
Habitat Quality	Trees and debris will be cleared and removed within the flooded area of the Stage 1 and Stage 2 TMF
Habitat Quantity	DFO will be consulted to develop offsetting as appropriate, with consideration of the “Fisheries Productivity Investment Policy: A Proponent’s Guide to Offsetting” (DFO 2013b)

5.6.4 Summary for Fish and Fish Habitat

Overall, the Project is expected to result in a net benefit to fish habitat and fish populations to the Forty Mile Brook and Nepisiguit River watersheds downstream of the Project. Best management practices for standard mitigation will be followed for all in- or near-water work during construction. Therefore, it is not anticipated that there will be any substantial changes in fish habitat or fish populations, including SAR/SOCC, during construction. With respect to operation, it is anticipated that the Project will result in equivalent or improved fish habitat conditions as a result in improvements in water quality due to the sequestration of historical legacies into the TMF. Ultimately, these habitat improvements may result in improved benthic invertebrate communities (i.e., food for fish), increased productivity and increased fish populations downstream of the Project, relative to existing conditions. Any habitat that is lost as a result of the Project will be offset in consultation with DFO and in consideration of the “Proponent’s Guide to Offsetting” (DFO 2013b).

Surface water quality monitoring (i.e., trace metals, temperature, dissolved oxygen) is planned for the summer of 2018 along the length of Forty Mile Brook to confirm existing conditions and predict potential changes to water quality in Forty Mile Brook as a result of the Project. Additional habitat assessments are anticipated in Forty Mile Brook to support the *Fisheries Act* authorization. The Caribou mine will continue ongoing EEM and characterization of effluent to monitor water quality, sediment quality, and the fish and benthic invertebrate communities within the receiving environment as described in the MDMER.

5.7 ASSESSMENT OF POTENTIAL INTERACTIONS WITH VEGETATION AND WETLANDS

This section describes the potential environmental interactions between the Project and vegetation and wetlands.

5.7.1 Scope of the Assessment

The vegetation and wetlands VC includes consideration of: vegetation communities (including Ecological Communities of Management Concern (ECMC)), vascular plant Species at Risk (SAR) and Species of Conservation Concern (SOCC), and wetlands. These components constitute a VC due to:

- The importance placed on them by the people of New Brunswick, who recognize their environmental and socioeconomic value;
- The potential environmental effects of the Project on vegetation and wetlands;
- The regulations protecting vegetation and wetlands; and
- The relationship between vegetation and wetlands and other VCs, such as fish and fish habitat, wildlife and wildlife habitat, and current use of land and resources for traditional purposes by Indigenous persons.

A focus of this VC is on vegetation SAR and SOCC. SAR include species listed as *extirpated*, *endangered*, *threatened*, or *special concern* in Schedule 1 of the federal SARA, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), or the NB SARA. SAR ranked *extirpated, endangered* or *threatened* by SARA or NB SARA currently have regulatory protection under Schedule 1 of the federal SARA or as per the *Prohibitions Regulation* and Section 28 of NB SARA. The definition used in this document also includes species on the NB SARA *List of Species at Risk Regulation* and those listed by COSEWIC that may become protected within the timeframe of this Project, at the request of ECCC from past environmental assessments conducted in New Brunswick.

SOCC are species not listed or protected by any legislation, but are considered rare in New Brunswick or their populations may not be considered sustainable. SOCC are here defined to include species that are not SAR, but are ranked S1 (*critically imperiled*), S2 (*imperiled*), or S3 (*vulnerable*) in New Brunswick by the Atlantic Canada Conservation Data Centre (AC CDC 2018b).

ECMC are typically vegetation communities that have been identified as fulfilling special management objectives on Crown land in New Brunswick, or areas that have been identified, either through field work or by local conservation organizations, as supporting unique ecological features (e.g., Environmentally Significant Areas (ESA)). Provincially-identified forest stands that fulfill biodiversity or wildlife management objectives on Crown land are known as conservation forest, and include protected natural areas, old forest communities, old forest wildlife habitat, deer wintering areas, and watercourse and waterbody buffer zones. ESAs, initially identified by the New Brunswick Nature Trust, support natural features that might be sensitive to disturbance by development. These areas can be of geological or ecological interest and are identified by a single point location in the AC CDC database. These areas have no legislated protection, but can represent known locations or important habitat for plant SAR or SOCC and are thus also considered ECMC.

Wetlands are defined as lands that are permanently or temporarily submerged by water near the soil surface for long enough to maintain wet or poorly drained soils, support plants adapted to saturated soil conditions, and have other biotic conditions characteristic of wet environments (NBDNRE and NBDELG 2002). Wetland conservation is addressed in both *The Federal Policy on Wetland Conservation* (GOC 1991) and the New Brunswick *Wetlands Conservation Policy* (NBDNRE and NBDELG 2002). The federal policy aims to protect wetlands on federal lands and waters or within federal programs where wetland loss has reached critical levels, and also within federally designated wetlands, such as Ramsar sites (GOC 1991). In New Brunswick, regulation and conservation of wetlands are under the jurisdiction of NBDELG. The provincial wetland policy focuses on protecting wetlands in New Brunswick through securement, increasing education and awareness, and maintaining wetland function. These policy goals are enforced through the New Brunswick *Clean Water Act* and associated *Watercourse and Wetland Alteration* (*WAWA) Regulation*, and the New Brunswick *Clean Environment Act* and associated *Environmental Impact Assessment Regulation* (*EIA Regulation*).

The PDA is the immediate area encompassing the Project footprint, and this is defined in Section 2.2. The LAA is defined as the maximum area where Project-specific environmental interactions can be predicted and measured with a reasonable degree of accuracy and confidence (i.e., the zone of influence of the Project on vegetation and wetlands). The LAA for vegetation and wetlands includes the PDA, and a 500 m buffer around the PDA (Figure 5.13).

5.7.2 Existing Conditions for Vegetation and Wetlands

5.7.2.1 Information Sources

Information on vascular plant SAR and SOCC were obtained from the AC CDC. AC CDC data, including SAR, SOCC, and managed areas, were obtained for the area within 25 km of the Project (AC CDC 2018a). The AC CDC data report obtained for the Project is included in Appendix A.

Information on ECMC was gathered from NBDERD and AC CDC. The AC CDC maintains data on managed and biologically significant areas within New Brunswick, including ESAs. Provincial conservation forest information and AC CDC data on managed and significant areas was reviewed to identify ECMC within the LAA.

Land use data were obtained from NBDERD and NBDELG for the LAA. Forest stands were classified into one of three maturity classes: regeneration – sapling, young – immature, or mature – overmature, and one of three species composition classes: hardwood, mixedwood, or softwood. Stands with both hardwood and softwood species, with both equaling less than 70% are considered mixedwood. No forestry data were available for industrial freehold land.

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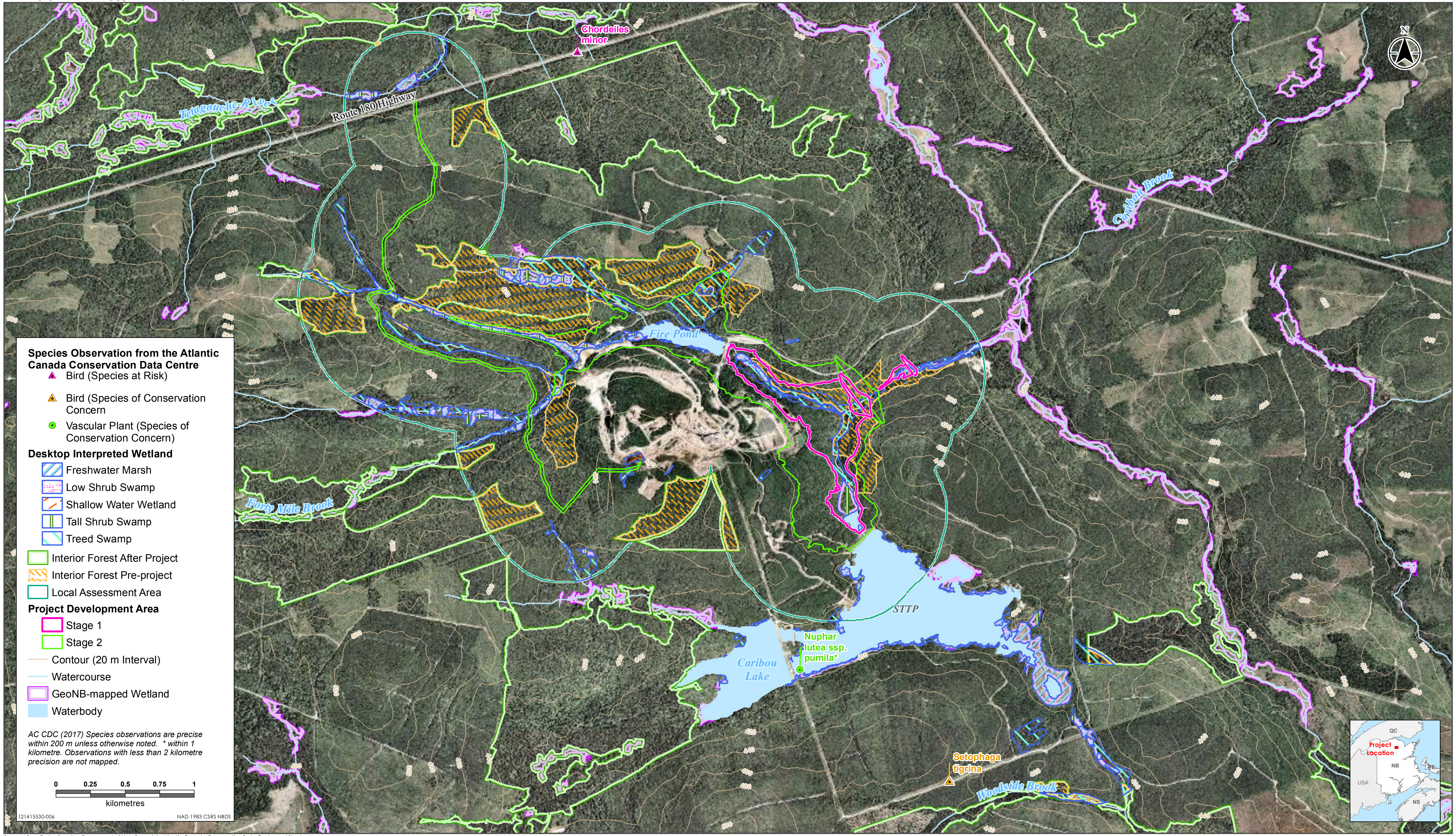

Sources: Base Data - from the Government of New Brunswick, Atlantic Canada Conservation Data Centre and Stantec.
Service Layer Credits: Service New Brunswick/Service Nouveau Brunswick

Local Assessment Area for Terrestrial Environment

Stantec

121415530 - TREVALI MINING (NEW BRUNSWICK) LTD.

Figure 5.13

GeoNB-mapped wetlands are regulated by the NBDELG and were classified into the Canadian Wetland Classification System (NWWG 1997). This system classifies wetlands to three levels: class, form/subform, and type. There are five wetland classes: bog, fen, swamp, marsh, or shallow water. Form and subform indicate the physical morphology and hydrological characteristics of the wetland. Wetland type distinguishes wetland communities based on one of eight groups of dominant vegetation.

5.7.2.2 Environmental Setting

The Project is located on the border of the Tetagouche Ecodistrict within the Northern Uplands Ecoregion, and the Ganong Ecodistrict within the Highlands Ecoregion (NBDNR 2007).

The Northern Uplands Ecoregion arcs across the northern-most portion of New Brunswick and is seated between the two separate portions of the Highlands Ecoregion. This ecoregion is climactically intermediate between the colder Highlands Ecoregion and the slightly warmer and wetter Central Uplands Ecoregion. The vegetation and fauna within this ecoregion consequently display a mixture of northern and southern affiliations, giving the area an ecologically distinctive character (NBDNR 2007).

The Tetagouche Ecodistrict is situated in the transitional area between the highlands of the Ganong and Upsalquitch ecodistricts to the west and the lower terrain of the Tjigog Ecodistrict to the east. This ecodistrict is intermediate in elevation, and lies within a partial rain shadow created by the highlands of the Gaspé Peninsula, giving the ecodistrict a moderately dry, cool climate. The vegetation here is largely coniferous forest consisting mainly of balsam fir (*Abies balsamea*) with some white spruce (*Picea glauca*) and black spruce (*Picea mariana*). Stands dominated by eastern white cedar (*Thuja occidentalis*), white spruce and black spruce are found on wet sites along rivers and moist gently sloping flatlands. Intolerant hardwood species include white birch (*Betula papyrifera*) and trembling aspen (*Populus tremuloides*) (NBDNR 2007).

The eastern portion of Highlands Ecoregion, located in northern New Brunswick (which interacts with the Project) spans the mountainous terrain of north-central New Brunswick and includes Mount Carleton and the Christmas Mountains. The combination of rough topography and high elevation within this ecoregion results in a cool, wet climate characterized by mist wrapped mountains in summer, and heavy snowfalls in winter (NBDNR 2007).

The Ganong Ecodistrict is situated in north-central New Brunswick and is encircled by the lower terrain of the Southern and Northern Uplands. This ecodistrict has the lowest annual average temperatures in New Brunswick due to its high elevations and the resultant cold, wet climate. Balsam fir and black spruce dominate the forest, with balsam fir being more prevalent in the northern terrain. Beech (*Fagus grandifolia*) is absent, and trembling aspen is limited mainly to roadsides and to low elevations in the Nepisiguit River valley. This ecodistrict displays boreal and subarctic elements which yield an unusual assemblage of flora and fauna (NBDNR 2007).

5.7.2.3 Vegetation Communities

Land classification data (e.g., forest types, wetlands, and anthropogenic land uses), presented as both hectares (ha) and percentages, are summarized in Table 5.15 for the PDA (Stages 1 and 2) and the LAA. The LAA is illustrated in Figure 5.13, and represents the area within 500 m of, and including, the PDAs.

Table 5.15 Land Classification within the PDA and LAA

Land classification type	Area (ha) or percentage (%) within Land classification type					
	PDA – Stage 1		PDA – Stage 2		LAA[1]	
	hectares (ha)	%	hectares (ha)	%	hectares (ha)	%
Anthropogenic						
Industrial	1.34	3.14	12.18	10.63	79.91	7.12
Infrastructure	-	-	0.77	0.67	9.63	0.86
Forest						
Mature/Overmature Hardwood	-	-	2.92	2.55	111.88	9.97
Mature/Overmature Mixedwood	7.02	16.44	17.93	15.64	127.19	11.34
Mature/Overmature Softwood	7.93	18.57	17.77	15.50	127.20	11.34
Immature/Young Softwood	0.14	0.34	0.88	0.77	123.35	11.00
Immature/Young Hardwood	5.18	12.14	16.40	14.31	174.33	15.54
Immature/Young Mixedwood	0.31	0.73	3.26	2.85	95.37	8.50
Clearcut	5.23	12.25	18.59	16.21	158.97	14.17
Wetland[2]						
Freshwater Marsh	1.69	3.95	2.74	2.39	11.13	0.99
Low Shrub Swamp	-	-	-	-	0.32	0.03
Shallow Water Wetland	-	-	0.20	0.18	1.32	0.12
Tall Shrub Swamp	2.33	5.45	3.20	2.79	12.78	1.14
Treed Swamp	10.54	24.69	11.10	9.69	58.51	5.22
Waterbody	0.98	2.30	6.68	5.82	29.86	2.66
Total	42.68	100	114.62	100	1,121.74	100

1 Includes PDA of both stages.
2 Includes GeoNB mapped wetland, and desktop delineated wetland.
Sources: NBDERD 2014, 2017a, 2017b; NBDELG 2011

5.7.2.4 Vascular Plant SAR and SOCC

An AC CDC data request was submitted for the area surrounding the PDA. Table 5.16 lists the 27 plant SOCC that have been historically recorded within 25 km of the PDA, as reported by AC CDC; (note that the fact that a species has been historically recorded in an area is not an indication that that species will remain present at that location or within the LAA; rather, it simply means that it had been recorded at that location at some time in the past and thus has an elevated potential of being present there (or nearby) in the future). One SOCC observation was reported within 5 km of the PDA (*Nuphar lutea* ssp. *Pumila* (Small yellow pond-lily)), in boggy pond habitat associated with Caribou Lake. No plant SAR have been historically reported within 25 km of the PDA, and none are expected.

Table 5.16 Plant SOCC Historically Identified within 25 km of the PDA

Scientific Name	Common Name	AC CDC General Status Rank[1]	CESCC[2] General Status Rank	Habitat	Potentially Present in the PDA? (based on habitat modelling)
Agrostis mertensii	northern bent grass	S2	May be at Risk	In rock crevices and gravelly soil	No
Betula glandulosa	glandular birch	S1	May be at Risk	On rocky and peaty barrens of subalpine and boreal summits	No
Calypso bulbosa var. americana	calypso	S2	May be at Risk	Old growth calcareous cedar swamps, occasionally in other old growth calcareous swamps	No
Carex haydenii	Hayden's sedge	S3	Secure	Wet meadows and rocky shores	Yes
Carex ormostachya	necklace spike sedge	S3	Secure	Rich hardwood forests	No
Carex rostrata	narrow-leaved beaked sedge	S2	Sensitive	Along wet, boggy shores and meadows	Yes
Cynoglossum virginianum var. boreale	wild comfrey	S1	May be at Risk	Rich, often calcareous woods and thickets	No
Dryopteris fragrans var. remotiuscula	fragrant wood fern	S3	Secure	On dry, often exposed ledges	No
Erigeron hyssopifolius	hyssop-leaved fleabane	S3	Secure	Calcareous ledges and shores	No
Galium obtusum	blunt-leaved bedstraw	S2?	Secure	Shores and similar wet places, boggy swales and wet thickets	Yes
Geocaulon lividum	northern commandra	S3S4	Secure	Sphagnous bogs and sandy coniferous woods	Yes
Geranium bicknellii	Bicknell's crane's-bill	S3	Secure	Disturbed soils, burns and clearings	Yes
Goodyera oblongifolia	Menzies' rattlesnake plantain	S2	Sensitive	Damp old growth cedar or other coniferous or mixed woods	Yes
Listera auriculata	auricled twayblade	S2S3	Sensitive	Alder thickets and cedar swamps, and on the banks of rivers and streams	Yes
Littorella uniflora	American shoreweed	S3	Secure	Shallow water and along muddy shores of lakes	Yes
Lycopodium sabinifolium	ground-fir	S3	Secure	Dry woods and pasture	No

Table 5.16 Plant SOCC Historically Identified within 25 km of the PDA

Scientific Name	Common Name	AC CDC General Status Rank[1]	CESCC[2] General Status Rank	Habitat	Potentially Present in the PDA? (based on habitat modelling)
Nuphar lutea ssp. Pumila	small yellow pond-lily	S3	Secure	Lakes, ponds, sluggish streams, and backwaters	Yes*
Nuphar lutea ssp. Rubrodisca	red-disked yellow pond-lily	S2	Sensitive	Lakes, ponds, sluggish streams, and backwaters	Yes
Potamogeton obtusifolius	blunt-leaved pondweed	S3	Secure	Ponds, lakes and slow flowing streams, often on a substrate of deep muck	No
Potamogeton richardsonii	Richardson's pondweed	S3	Sensitive	Lakes and rivers in brackish or alkaline waters	No
Pyrola minor	lesser pyrola	S3	Secure	Cool, moist woods	Yes
Ranunculus longirostris	eastern white water-crowfoot	S1S2	May be at Risk	Low acidity, brackish, slow or still waters	No
Rumex aquaticus var. fenestratus	western dock	S1S2	May be at Risk	Wet soil of swamps, swales and shores	Yes
Stachys pilosa	hairy hedge-nettle	S3S4	Undetermined	Alluvial shores	No
Vaccinium boreale	northern blueberry	S1	May be at Risk	Peaty barrens	No
Vaccinium uliginosum	alpine bilberry	S1	May be at Risk	Cool coastal bogs and subalpine summits	No
Veronica serpyllifolia ssp. Humifusa	thyme-leaved speedwell	S3	Secure	On shores and seepage areas	Yes

NOTES:

1 S1 = critically imperiled, S2 = imperiled, S3 = vulnerable, S4 = apparently secure, S5 = secure, SNA = not applicable (typically exotic species), S#S# = a numeric range rank used to indicate any range of uncertainty about the status of the species or community (AC CDC 2018b).

2 Canadian Endangered Species Conservation Council

* Reported by AC CDC within 5 km of the PDA, associated with Caribou Lake.

A habitat modelling exercise was conducted by a Stantec botanist to determine which of these species could potentially be present within the PDA. A variety of information sources were used to determine what habitat types were present in the PDA including forest inventory mapping, provincial wetland mapping, and aerial imagery. The habitat requirements of the plant SOCC historically recorded within 25 km of the PDA were derived from a literature review, and the habitat preferences of the plant SOCC historically found within 25 km of the PDA were compared to the habitats present within the PDA. If suitable habitat for a particular SOCC species was believed to be present, that species was considered to be potentially present in the PDA.

The results of the habitat modelling exercise suggest that 13 of the 27 plant SAR and SOCC species historically recorded within 25 km of the PDA could potentially be present within the PDA, as noted in Table 5.16. Five of the plant SOCC (Hayden's sedge, narrow-leaved beaked sedge, blunt-leaved bedstraw, auricled twayblade, and western dock) could potentially be present in wetlands in the PDA. Thyme-leaved speedwell could occur in seepage tracks on slopes within the PDA or along damp stream banks. The aerial imagery revealed the presence of several natural and man-made ponds within the PDA that could support populations of small yellow pond-lily and red-disked yellow pond-lily. Areas of mature coniferous forest are present within the PDA that could potentially provide habitat for northern commandra, Menzies' rattlesnake plantain, and lesser pyrola. American shoreweed could potentially be found around the shore of the existing tailing storage facility. Bicknell's crane's-bill typically establishes on clear-cuts within a few years following harvesting. Clear-cuts are present within the PDA.

Field work to be conducted in the summer of 2018 within the Stage 1 PDA (and later prior to development of the Stage 2 PDA) will confirm the presence or absence of plant SAR or SOCC in the PDA.

5.7.2.5 Wetlands

There are 3 GeoNB-mapped (regulated) wetlands within the Stage 1 PDA, 5 additional GeoNB-mapped wetlands in the Stage 2 PDA, and a total of 22 GeoNB-mapped wetlands within the LAA (outside the Stage 1 and Stage 2 PDAs). The total area of GeoNB-mapped wetland within the PDA is 7.30 ha (i.e., 3.56 ha in the Stage 1 PDA, and an additional 3.74 ha in the Stage 2 PDA), with a total of 19.37 ha within the LAA.

In addition to reviewing the GeoNB-mapped wetlands, an experienced wetland biologist conducted a desktop delineation of unmapped wetlands within the PDA (for both Stages) and LAA utilizing aerial imagery and GIS technology. This delineation increased the total estimated area of potential wetland (including the GeoNB-mapped wetlands) within the PDA to 31.80 ha (i.e., 14.56 ha of wetland in the Stage 1 PDA, and an additional 17.24 ha of wetland within the Stage 2 PDA), with a total of 84.06 ha of wetland and potential wetland within the LAA (Table 5.15).

5.7.2.6 Ecological Communities of Management Concern

There is no conservation forest in the LAA. No ECMC have been identified within the 5 km of the PDA. The closest Protected Natural Area (PNA), Mount Akroyd, is 16 km northwest of the PDA.

5.7.3 Potential Environmental Interactions with Vegetation and Wetlands

5.7.3.1 Construction Phase

Construction activities have the potential to result in adverse environmental interactions with vegetation and wetlands, which could result in changes to plant SAR and SOCC, and wetlands, including:

- Direct and indirect physical disturbance of habitat for vascular plants (which also harbours various species of wildlife);
- Indirect effects on adjacent plant communities through the introduction of edge effects;
- Potential introduction of invasive plant species; and,
- Conversion of upland and wetland plant communities to aquatic communities.

The Project will cause a change in vegetation communities during construction. Site preparation, including clearing and grubbing within the PDA will remove trees and shrubs and will damage understory plants. Grubbing will completely remove vegetation, including SAR or SOCC, if present. Topsoil and the associated seedbank may also be removed. Heavy machinery driving through the site will cause soil compaction. Removing and compacting soil will result in a change in habitat quality for plants in any areas that may not be completely developed. Thus, any areas that are cleared and grubbed and then allowed to revegetate may have different plant communities establish because of changed habitat characteristics.

Removal of vegetation within cleared and grubbed areas can have indirect environmental effects on adjacent areas through edge effects. Edge effects occur though removal of adjacent vegetation, particularly overstory trees, which results in changes to abiotic factors such as temperature, humidity, wind, and light availability. Changes to these habitat conditions can alter which plant species can survive in an area. SAR and SOCC are often rare because they have very specific habitat requirements. If SAR or SOCC are within areas adjacent to cleared and grubbed areas, they may be adversely affected by the changes resulting from edge effects. Edges also provide greater access for invasive plants to colonize an existing vegetation community. Most invasive plants are good colonizers and strong competitors, and can out-compete native vegetation, particularly in disturbed habitats. Invasive species can be introduced and spread throughout the PDA by use of equipment that was used in areas occupied by invasive plants.

Flooding of the previously cleared areas to form the new TMF basin will result in the permanent conversion of upland and wetland plant communities to aquatic systems. The storage of tailings in the TMF basin is expected to greatly curtail the ability of aquatic plant communities to establish in the basin and for wetland plant communities to establish along the margin of the basin. This could be attributable to several factors including:

- Continuous deposition of tailings which will smother plant communities establishing on the bottom substrate;
- Reduced depth of the photic zone caused by suspension of tailings particles in the water column; and,
- The presence of high concentrations of metals and high acidity.

There may be some adverse effects on wetland hydrology in areas where the increased water level in the TMF causes water to back-up in existing wetlands to the point where it causes changes in wetland plant community structure but does not convert the wetlands to aquatic systems (water depths greater than 2 m). These hydrological effects may extend some distance outside of the Stage 1 and Stage 2 PDAs.

Overall, to carry out the Project, some vegetation communities and wetlands occurring within and immediately adjacent to the PDA will necessarily be lost to make way for the new TMF and associated infrastructure. The total predicted loss of GeoNB wetlands in Stage 1 is 3.56 ha, and the loss of 11.00 ha of additional potential wetland. Though the PDA does contain some forest habitat, wetland, and potentially some SAR (unlikely) or SOCC subject to confirmation through field work in summer 2018, the habitat in the PDA is not unique and is readily abundant in the ecoregions, and the PDA does not contain critical habitat for SAR. The potential interactions between the Project and vegetation and wetlands will be mitigated by measures listed in Section 5.7.3.4. With the implementation of mitigation, the potential interactions between the Project and vegetation and wetlands during construction is not expected to be substantive on the local, regional, or provincial scale.

5.7.3.2 Operation Phase

Operation activities may adversely affect wetlands and plant SAR and SOCC through indirect exposure to acidic, metal contaminated water present in the TMF and to a lesser extent, to residual contaminants contained in treated wastewater released from the TMF. Plants growing near the shore of the TMF may have their roots exposed to the contaminated water that percolates into the land around the shore. The width of this contaminated zone along the shore of the TMF will tend to be narrow, varying in width depending on the steepness of the shore as well as the direction and volume of groundwater flow within the rooting depth of the shoreline vegetation.

Indirect effects on adjacent plant communities may also occur as a result of localized changes in hydrology associated with the presence of the TMF itself and the sequestration of mine contact water in the TMF. The presence of the TMF will result in the loss of wetlands currently within the Stage 1 PDA. The absence of these wetlands may result in a decreased level of soil moisture within the areas directly adjacent to the PDA. This decrease in soil moisture could result in a change of species composition of vegetation growing directly adjacent to the PDA. Since sequestration of mine contact water into the current TMF is already occurring (though at a different location, in the STTP), the indirect effects of Stage 1 on adjacent plant communities or wetlands (if present) through changes in hydrology will likely be minor.

Overall, the operation of the Project is not expected to result in further physical disturbance of vegetation or wetlands that did not already occur during construction (including initial flooding), but may result in some small-scale effects to vegetation or wetlands due to changes in water quantity or quality. Periodic monitoring of wetland function and adjacent vegetation communities to the PDA will be conducted during operation, and any substantial changes to vegetation communities or wetlands indirectly affected by the Project will trigger the need for further mitigation or adaptive management, as appropriate.

5.7.3.3 Closure/Post-Closure Phase

The closure phase of the Project, which includes the Stage 2 PDA, will be expected to have environmental effects on vegetation and wetlands like those predicted for construction of the Stage 1 PDA. The total predicted loss of GeoNB wetlands in Stage 2 is 3.74 ha, and the loss of 13.50 ha of additional potential wetland.

5.7.3.4 Mitigation for Vegetation and Wetlands

The following well-established practices to reduce the interaction between the Project and vegetation and wetlands will be implemented during the various phases of the Project, as applicable.

- Conduct confirmatory field work in the Stage 1 PDA (summer 2018) and Stage 2 PDA (later, prior to any construction for Stage 2) to confirm the presence or absence of plant SAR and SOCC.
- Conduct confirmatory field work in the Stage 1 PDA (summer 2018) and Stage 2 PDA (later, prior to any construction for Stage 2) to delineate and evaluate the function of wetlands in the PDAs.
- Avoid, to the extent feasible, known locations of plant SAR and SOCC.
- Restrict clearing activities to the minimum amount required, particularly around wetlands.
- Employ standard erosion and sedimentation control measures, particularly to avoid silt laden runoff into wetlands.
- Implement standard dust control measures to avoid siltation of wetlands.

- Use quarried, crushed material for road building and construction of the dams in and near wetlands, to reduce the risk of introducing or spreading exotic and/or invasive vascular plant species.
- Equipment arriving on site should be cleaned before arriving on site to minimize the spread of invasive plant species.
- Operate vehicles and equipment on previously disturbed areas, wherever feasible.
- Limit size of temporary workspaces.
- Allow for natural regeneration when possible, and when not possible, use a native seed mix for revegetation, progressively during operation and at closure.
- Restore temporarily disturbed areas to pre-construction conditions.
- Rehabilitate access roads that are no longer needed.
- Compensate for net loss of wetland function of GeoNB-mapped wetlands arising as a result of the Project.
- Should any plant SAR or SOCC be found within the PDA during upcoming field surveys, NBDELG will be notified and mitigation to reduce the effect of the Project on these species will be developed in consultation with NBDELG.

The mitigation described above will reduce adverse effects on plant SAR/SOCC and wetlands. Some loss of wetland and possibly plant SAR/SOCC habitat is unavoidable, but the mitigation will reduce potential interactions with the plant SAR/SOCC and wetlands. Habitat for plant SAR/SOCC and wetlands will remain available in the surrounding landscape.

5.7.4 Follow-up for Vegetation and Wetlands

A follow-up plant SAR/SOCC survey will be conducted within the Stage 1 PDA during the 2018 growing season. Surveys within the Stage 2 PDA will follow the same methodology, conducted in the future, prior to construction within the Stage 2 PDA. A review of the flowering times of the plant SOCC that could potentially be present in the PDA (Table 5.16) suggests that a single botanical survey conducted in late July or the month of August will be sufficient to allow the detection of all of these species. All areas of the Stage 1 PDA will be visited during the survey with particular attention paid to wetlands, mature coniferous and mixedwood forest, shorelines, and seepage tracks. During the vascular plant survey, all species will be recorded, and a vascular plant species list will be compiled for the Project. A GPS location will be recorded for each incidence of vascular plant SAR or SOCC observed, along with any pertinent information for each plant, such as population size. Any plants for which the identification in the field is uncertain will be collected for laboratory identification.

Wetland surveys will be conducted within the Stage 1 PDA concurrently with vascular plant surveys; Stage 2 wetland surveys will be completed at a later time in the future, prior to construction of Stage 2. Wetlands will be delineated using a GPS and classified per the Canadian Wetland Classification System (NWWG 1997). Information on wetland function will also be recorded for each wetland. A WESP-AC or NovaWet wetland functional assessment will be conducted for each wetland present in the PDA in order to assess the wetland functions and services provided by these wetlands.

The results of these surveys will be provided in a supplemental report, to be submitted to the NBDELG for its review in parallel to the EIA review for the Project. Conditions observed in the field that might affect the assessment presented in this EIA Registration document will be described in the supplemental report.

5.7.5 Summary for Vegetation and Wetlands

Construction activities are expected to result in a permanent loss of an estimated 14.56 ha of wetland in the Stage 1 PDA, 3.56 ha of which is GeoNB-mapped wetland. Given the nature of the Project, there is little potential to avoid wetland habitat. Wetland compensation will be conducted for GeoNB-mapped wetlands for which a net loss of wetland function has occurred as a result of the Project, as determined by follow-up wetland monitoring. If wetland compensation takes the form of construction or enhancement of wetland habitat, it is recommended that wetland substrate from the affected wetlands be used in the construction or enhancement of the compensation wetland in order to provide a suitable substrate and a source of plant propagules.

There is potential for plant SAR/SOCC populations to be affected by construction activities. No field botanical surveys have been conducted yet, so it is not possible to know at this time whether plant SAR/SOCC are present and, if so, where they are located. An AC CDC data search revealed that no plant SAR and 27 plant SOCC have been historically recorded within 25 km of the Project. A rare plant habitat modeling exercise indicated that 13 of these plant SOCC could potentially be present in the PDA. Field botanical surveys will be conducted in 2018 to determine if these or other plant SAR/SOCC are present in the Stage 1 PDA. Little can be done to avoid plant SAR/SOCC populations that may be present in the proposed Stage 1 TMF. Plant SOCC that might be found in this area could be salvaged and moved to similar nearby habitat; however, this option is often unsuccessful due to a lack of information available regarding the specific habitat requirements of most rare plants.

The operation phase of the Project could have an adverse effect on upland and wetland plant communities present along the shoreline of the TMF. Exposure of the roots of these plants to acidic, metal-laden waters from the TMF could adversely affect their health. This potential adverse effect on plant communities is not expected to extend far from the edge of the shore of the TMF. Closure of the facility is not anticipated to have any substantial adverse effects on plant SAR/SOCC or wetlands in or near the PDA.

Closure activities (i.e., Stage 2 construction) are expected to result in a permanent loss of an estimated 17.24 ha of potential wetland habitat in the Stage 2 PDA, 3.74 ha of which is GeoNB-mapped wetland. Given the nature of the Project, there is little potential to avoid wetland habitat during Stage 2 construction except along the proposed alternative access road alignment, where rerouting might be possible if required. Wetland compensation will be conducted for GeoNB-mapped wetlands that experience a net loss of wetland function as a result of the Project, as determined by follow-up wetland monitoring.

Like in construction of the Stage 1 PDA, the Stage 2 PDA has potential to affect plant SAR/SOCC populations. Plant surveys will be conducted in support of closure assessments at that time. It will be possible to adjust the route of the alternative access road to avoid plant SAR/SOCC; however, little can be done to avoid plant SAR/SOCC populations that may be present in the proposed Stage 2 of the TMF, as noted above for construction.

In light of the above, and in consideration of the nature of the potential interactions between the Project and vegetation and wetlands as well as proposed mitigation, the Project is not expected to result in a substantive effects on vegetation and wetlands during all phases.

5.8 ASSESSMENT OF POTENTIAL INTERACTIONS WITH WILDLIFE AND WILDLIFE HABITAT

This section describes the potential environmental interactions between the Project and wildlife and wildlife habitat.

5.8.1 Scope of the Assessment

The wildlife and wildlife habitat VC includes consideration of wildlife species (including Species at Risk (SAR) and Species of Conservation Concern (SOCC)) and their habitats. Specifically, this VC focuses on birds, mammals, and herptiles, and their habitats, including Ecological Communities of Management Concern (ECMC), which are communities that fulfill special management objectives on Crown land in New Brunswick or have been identified as supporting unique ecological features, either through field work or by local conservation organizations. Wildlife and wildlife habitat are valued by the people of New Brunswick for their environmental and socioeconomic importance. Wildlife and wildlife habitat has been selected as a VC due to the potential for interactions between the Project and wildlife SAR, SOCC, and wildlife habitats including ECMC.

SAR and SOCC for wildlife are defined in the same manner as in Section 5.7.1 above.

The PDA is the immediate area encompassing the Project footprint, and this is defined in Section 2.2. The LAA is defined as the maximum area where Project-specific environmental interactions can be predicted and measured with a reasonable degree of accuracy and confidence (i.e., the zone of influence of the Project on wildlife and wildlife habitat). The LAA for wildlife and wildlife habitat includes the PDA, and a 500 m buffer around the PDA (Figure 5.13, Section 5.7).

5.8.2 Existing Conditions for Wildlife and Wildlife Habitat

5.8.2.1 Information Sources

Records for wildlife, including avian species, known to have been historically observed within the LAA and surrounding area, were obtained from various sources including the AC CDC, and Maritimes Breeding Bird Atlas (MBBA). These data sources are described below. The North American Breeding Bird Survey (BBS) and Atlantic Canada Nocturnal Owl Survey (ACNOS) were also consulted; however, neither of these data sources contained data within 10 km of the LAA. The AC CDC data report obtained for the Project is included in Appendix A.

AC CDC data, including SAR, SOCC, and managed areas, were obtained within 5 km and 25 km of the Project (AC CDC 2018a).

Maritimes Breeding Bird Atlas data were obtained via the NatureCounts.ca website for the atlas squares 19FN07 and 19FN06, which encompass the PDA and LAA.

5.8.2.2 Environmental Setting

The Project is located on the border of the Tetagouche Ecodistrict within the Northern Uplands Ecoregion, and the Ganong Ecodistrict within the Highlands Ecoregion, located just south of the mine. See Section 5.7.2 for a description of the Ecodistricts within which the Project is located.

Land use class data indicates that most of the LAA is occupied by forest cover, primarily immature/young softwood and hardwood stands. A summary of land class uses within the PDA and LAA were presented in Table 5.15 in Section 5.7.

5.8.2.3 Ecological Communities of Management Concern and Interior Forest

No Ecological Communities of Management Concern (ECMC), or other managed areas, have been identified within 5 km of the PDA.

Interior forest is defined as patches of mature forest greater than 10 ha in size, and at least 100 m from an "edge" (*e.g.*, clearcut, industrial or other anthropogenic area, linear features such as roads or transmission lines, or waterbodies and open wetlands). Interior forest represents areas relatively free from fragmentation, and is important within a greater landscape because some bird species, known as interior species, are particularly sensitive to fragmentation and may require interior forest habitat. Some examples of interior species include bay-breasted warbler, black-throated blue warbler, and the SAR eastern wood-pewee, Canada warbler, and wood thrush.

An analysis of the most recent forestry data (NBDERD 2017a), dated 2008, indicates there is up to 5,438.89 ha of interior forest contiguous to the LAA (*i.e.*, some part of the interior forest patch is within the LAA), within 10 patches. These patches range in size from 13.38 ha to 4,737.52 ha. These values may be smaller at present due to forestry cutting which may have taken place since 2008, and not apparent in more recent satellite imagery (i.e., 2013 Google Earth satellite imagery).

5.8.2.4 Bird SAR and SOCC

Atlantic Canada Data Conservation Centre

The AC CDC reported historical observations for a total of 49 bird species within a 5 km radius of the PDA (Table B.1, Appendix B; AC CDC 2018a). This list includes four SAR and one SOCC.

Maritimes Breeding Bird Atlas

The PDA of the Project interacts with one MBBA square (19GN07). The LAA interacts with an additional square to the south (19GN06). During the most recent atlas period (2006-2010), a total of 75 bird species (Table B.1, Appendix B) were historically recorded within the squares with which the Project interacts, including two SAR. Of the 75 historically recorded species within the two squares, 13 species were confirmed as breeding, 12 were recorded as probable breeders, and 50 were recorded as possible breeders.

The combined information sources indicate that a total of 77 species of birds have been historically recorded within 5 km of the PDA or within the MBBA square within which the PDA lies (Table B.1, Appendix B). Of the species recorded, four are SAR and two are SOCC (Table 5.18)

Table 5.17 Historical Records of Bird SAR and SOCC Reported Within 5 km of the Project Site

Common Name	Scientific Name	SARA Status	COSEWIC Status	NB SARA Status	AC CDC S-Rank[1]	Data Source
SAR						
common nighthawk	Chordeiles minor	Schedule 1, Threatened	Threatened	Threatened	S3B, S4M	AC CDC, MBBA
barn swallow	Hirundo rustica	Schedule 1, Threatened	Threatened	Threatened	S2B, S2M	AC CDC, MBBA
evening grosbeak	Coccothraustes vespertinus	No Schedule, No Status	Special Concern	-	S3B, S3S4N	AC CDC
Canada warbler	Cardellina canadensis	Schedule 1, Threatened	Threatened	Threatened	S3B, S3M	AC CDC, MBBA
SOCC						
pine siskin	Spinus pinus	-	-	-	S3	MBBA
Cape May warbler	Setophaga tigrina	-	-	-	S3B, S4S5M	AC CDC, MBBA

[1] S1 = *critically imperiled*, S2 = *imperiled*, S3 = *vulnerable*, S4 = *apparently secure*, S5 = *secure*, SNA = *not applicable* (typically exotic species) S#S# = a numeric range rank used to indicate any range of uncertainty about the status of the species or community. B= Breeding, M = Migrant. (AC CDC 2018b)

The most recent land use data suggests that suitable habitat may also be available in the LAA for the following bird SAR:

- Olive-sided flycatcher (*Contopus cooperi*);
- Eastern wood-pewee (*Contopus virens*) and
- Rusty blackbird (Euph*agus carolinus*).

Potentially suitable habitat for these species will be surveyed during the summer of 2018 to determine whether they may be present within the PDA and LAA. A discussion of the SAR listed in Table 5.18, and those SAR identified as being potentially present in the LAA based upon land use data, is provided below.

Common Nighthawk

The common nighthawk is a medium-sized bird which nests in almost all of North America, and in some parts of Central America. This species occurs in all of the Canadian provinces and territories with the exception of Nunavut (COSEWIC 2007a). The common nighthawk is considered *threatened* under Schedule 1 of SARA and under NB SARA. The AC CDC ranks common nighthawk as S3B,S4M, indicating the breeding population is considered *vulnerable* and the migrating population is *apparently secure* in New Brunswick.

Common nighthawks are most commonly observed in a wide range of open, vegetation-free habitats including beaches, recently cleared forests, rocky outcrops, and grasslands. The species has probably benefited from newly-opened habitats created by the forestry industry (COSEWIC 2007a). There is potentially suitable habitat for this species in the PDA and LAA.

The loss of terrestrial habitat as a result of the Project could potentially reduce the availability of habitat used by common nighthawk, though the extent of removal will be small in comparison to available habitat in and near the LAA. There are no features of the terrestrial habitat within the PDA affected by the Project that will eliminate habitat for common nighthawk that is not available elsewhere in the LAA. Suitable habitat for this species is relatively abundant, and often created by the forestry industry.

Olive-sided Flycatcher

The olive-sided flycatcher (*Contopus cooperi*) is a stout, medium-sized passerine which breeds in scattered locations throughout most of forested Canada (COSEWIC 2007b). This species is listed as *threatened* under Schedule 1 of SARA and NB SARA. The AC CDC lists the olive-sided flycatcher as S3B,S3M, indicating that the breeding and migratory populations of this species are considered *vulnerable* in New Brunswick.

Olive-sided flycatchers are most often associated with open areas, where they are found foraging for flying insects, and perching in tall live trees (COSEWIC 2007b). Potentially suitable habitat for this species is found within the PDA and LAA. The most recent MBBA (2018) data suggests the relative abundance of olive-sided flycatcher in the area of the Project is approximately 0.25-0.5 birds per 15 point counts, compared with a relative abundance of 1+ per 15 point counts in the most densely populated areas.

Olive-sided flycatcher was reported by the AC CDC as having been historically recorded within approximately 11 km of the PDA, and could potentially be found within the PDA or LAA. The loss of terrestrial habitat as a result of the Project could potentially reduce the availability of habitat used by olive-sided flycatcher, though the extent of removal will be small in comparison to available habitat in and near the LAA. There are no features of the terrestrial habitat within the PDA affected by the Project that will eliminate habitat for olive-sided flycatcher that is not available elsewhere in the LAA and the surrounding Crown land.

Eastern Wood-pewee

The eastern wood-pewee (*Contopus virens*) is a small passerine which breeds in much of Canada from Saskatchewan to the Maritimes provinces (COSEWIC 2012). This species is ranked as *threatened* by COSEWIC and NB SARA. The AC CDC ranks this species as S4B,S4M, indicating that the breeding and migrating populations of this species is considered *apparently secure* in New Brunswick.

During breeding, the eastern wood-pewee is generally associated with the mid-canopy layer within forest clearings and edges of hardwood and mixed forest stands (COSEWIC 2012). In migration periods this species utilizes a variety of habitats including edges, and clearings (COSEWIC 2012). Potentially suitable habitat for this species is found within the PDA and LAA. The most recent MBBA (2018) data suggests the relative abundance of eastern wood-pewee in the area of the Project is approximately 0.01-0.16 birds per 15 point counts, compared with a relative abundance of 1.3+ per 15 point counts in the most densely populated areas.

Eastern wood-pewee was reported by the AC CDC as having been historically recorded within approximately 12 km of the PDA, and could potentially be found within the PDA or LAA. The loss of terrestrial habitat as a result of the Project could potentially reduce the availability of habitat used by eastern wood-pewee though the extent of removal will be small in comparison to available habitat in and near the LAA. There are no features of the terrestrial habitat within the PDA affected by the Project that will eliminate habitat for eastern wood-pewee that is not available elsewhere in the LAA.

Barn Swallow

The barn swallow is a mid-sized passerine that is closely associated with rural human settlements. This species is the most widespread swallow in the world, and is known to breed in all provinces and territories in Canada (COSEWIC 2011). The barn swallow is ranked as *threatened* under Schedule 1 of SARA and under NB SARA, and S2B,S2M by the AC CDC indicating that the breeding and migrating populations of this species are considered *imperiled* in New Brunswick. It has no SARA rank at this time.

Following European settlement of North America, barn swallows shifted from nesting in caves and on ledges to nesting largely in man-made structures. This insectivorous species prefers open habitats for foraging such as pastoral lands, shorelines, and cleared rights-of-way. Some potentially suitable habitat for this species may be available in the PDA, as there are a limited number of man-made structures within the PDA. The most recent MBBA (2018) data suggests the relative abundance of barn swallow in the area of the Project is approximately 0.01-0.02 birds per 15 point counts.

The loss of terrestrial habitat as a result of the Project could potentially reduce the availability of habitat used by barn swallow, though the extent of removal will be small in comparison to available habitat in and near the LAA. There are no features of the terrestrial habitat within the PDA affected by the Project that will eliminate habitat for barn swallow that is not available elsewhere in the LAA.

Evening Grosbeak

The evening grosbeak is a brightly coloured, heavyset finch species of northern coniferous forests. This species breeds in all of the Canadian provinces and territories except Nunavut (COSEWIC 2016a). Evening grosbeak is ranked as *special concern* by COSEWIC, and as S3B,S3S4N by the AC CDC, indicating that the breeding population of this species are considered *vulnerable* in New Brunswick, and that the migrating population is considered between *vulnerable* and *apparently secure* in New Brunswick.

This species is dependent upon insect outbreaks, which makes defining its preferred nesting habitat difficult. It is generally associated with older coniferous and mixed forests, but can utilize various habitats if insect prey are abundant (MBBA 2018). Outside of breeding season, this species relies upon seed crops from various trees in boreal forests, but is also attracted to ornamental trees which produce seeds or fruit, and bird feeders stocked with sunflower seeds. There is potentially suitable habitat for this species in the PDA and LAA. The most recent MBBA (2018) data suggests the relative abundance of evening grosbeak in the area of the Project is approximately 0.5-1 birds per 15 point counts.

The loss of terrestrial habitat as a result of the Project could potentially reduce the availability of habitat used by evening grosbeak, though the extent of removal will be small in comparison to available habitat in and near the LAA. There are no features of the terrestrial habitat within the PDA affected by the Project that will eliminate habitat for evening grosbeak that is not available elsewhere in the LAA.

Canada Warbler

Canada warbler is a small and brightly coloured passerine. Approximately 80% of the entire breeding range of this species is located in Canada (COSEWIC 2008), where it can be found breeding in every province and territory except Newfoundland and Labrador and Nunavut. Canada warbler is ranked as *threatened* on Schedule 1 of SARA and under NB SARA, and S3B,S3M by the AC CDC, indicating that the breeding and migrating populations of this species are considered *vulnerable* in New Brunswick.

Canada warblers breed in a wide range of forest types, including hardwood, softwood, and mixedwood forests. It is often associated with moist mixedwood forest, mature cedar swamps, and riparian shrub forests on slopes and ravines (COSEWIC 2008). The presence of a well-developed shrub layer also seems to be associated with preferred Canada warbler habitat. There is potentially suitable habitat for this species within the PDA and LAA. The most recent MBBA (2018) data suggests the relative abundance of Canada Warbler in the area of the Project is approximately 0.28-0.55 birds per 15-point counts, compared with a relative abundance of 1.1+ per 15 point counts in the most densely populated areas.

The loss of terrestrial habitat as a result of the Project could potentially reduce the availability of habitat used by Canada warbler, though the extent of removal will be small in comparison to available habitat in and near the LAA. There are no features of the terrestrial habitat within the PDA affected by the Project that will eliminate habitat for Canada warbler that is not available elsewhere in the LAA and the surrounding Crown land.

Rusty Blackbird

The rusty blackbird is a mid-sized passerine which breeds in most Canadian provinces, including New Brunswick. The Canadian range of this species extends from the Yukon to Newfoundland and includes all Canadian provinces and territories. This species is designated as *special concern* under Schedule 1 of SARA and NB SARA, and S3B,S3M by the AC CDC, indicating the breeding and migrating populations of this species are considered *vulnerable* in New Brunswick.

The breeding habitat of rusty blackbird is primarily forest wetlands such as slow-moving streams, bogs, and beaver ponds (COSEWIC 2006) of which there is some limited habitat in the LAA. Rusty blackbird overwinters primarily in damp woodlands or cultivated fields. During winter, this species can only be found in the most southerly parts of the Canadian provinces, while most of the population overwinters in the United States.

Rusty blackbird was reported by the AC CDC as having been historically recorded within approximately 11 km of the PDA, and could potentially be found within the PDA or LAA. The loss of terrestrial habitat as a result of the Project could potentially reduce the availability of habitat used by rusty blackbird though the extent of removal will be small in comparison to available habitat in and near the LAA. There are no features of the terrestrial habitat within the PDA affected by the Project that will eliminate habitat for rusty blackbird that is not available elsewhere in the LAA and the surrounding Crown land.

5.8.2.5 Other Wildlife SAR and SOCC

Information available from the AC CDC indicate that no other wildlife SAR or SOCC have been reported within 5 km of the PDA. Typical mammal species expected in the LAA will include moose (*Alces alces*), white-tailed deer

(*Odocoileus virginianus*), North American raccoon *(Procyon lotor*), North American porcupine (*Erethizon dorsatum*), red squirrel (*Tamiasciurus hudsonicus*), red fox *(Vulpes vulpes),* and snowshoe hare (*Lepus americanus*), all of which are considered secure in northern New Brunswick.

5.8.2.6 Bats

In late 2014, three bat species native to New Brunswick (little brown myotis (*Myotis lucifugus*), long-eared myotis (*Myotis septentrionalis),* and tri-colored bat (*Perimyotis subflavus*)) were listed as *endangered* under SARA and NB SARA following precipitous population declines as a result of white nose syndrome (WNS). WNS, which is caused by the introduced fungus *Pseudogymnoagscus destructans*, has resulted in the populations of these species being reduced by over 99% in New Brunswick (Parks Canada 2015).

No records of hibernacula for these species were reported by the AC CDC within 5 km of the PDA (AC CDC 2018a). The nearest historical record for a myotis bat (*Myotis lucifugus*) is 49 km from the PDA.

5.8.2.7 Herptiles

Two species of turtle, native to New Brunswick, are considered SAR: wood turtle (*Glyptemys insculpta*), ranked as *threatened* under SARA and NB SARA, and common snapping turtle (*Chelydra serpentina*), ranked as *special concern* under SARA and *NB* SARA). Neither of these species were historically identified within 5 km of the PDA by the AC CDC (AC CDC 2018a). The nearest record of wood turtle is 45 km from the PDA. No records of common snapping turtle were reported within 100 km of the PDA.

5.8.2.8 Monarch

The monarch (*Danaus plexippus*), is a migratory species of butterfly, native to New Brunswick. Monarchs are dependent upon the presence of milkweeds (numerous species) to complete their life cycle, and are typically found in the open and periodically disturbed habitats, including roadsides, fields, wetlands, prairies and open forests in which the plants grow. This species is ranked as *special concern* under SARA and NB SARA, and as *endangered* by COSEWIC (COSEWIC 2016b). In New Brunswick, the AC CDC ranks monarch as S3B,S3M, indicating both the breeding and migratory populations are considered *vulnerable*. No historical records of this species were identified within 5 km of the PDA by the AC CDC (AC CDC 2018a). The nearest record for this species reported by the AC CDC is within 83 km of the PDA.

5.8.3 Potential Environmental Interactions with Wildlife and Wildlife Habitat

This section describes how Project activities could interact with wildlife and wildlife habitat, as well as the techniques and practices that will be applied to mitigate the potential effects of these interactions.

5.8.3.1 Construction Phase

Construction activities have the potential to result in adverse environmental interactions with wildlife and wildlife habitat, which could result in changes to wildlife SAR and SOCC, and wildlife habitat, including:

- Direct and indirect physical disturbance, alteration, or loss of habitat for wildlife during construction; and
- Sensory disturbance to wildlife resulting in habitat avoidance during construction.

Vegetation clearing will take place at the TMF (Stage 1) and polishing pond dams, in the areas where flooding will take place to form the new TMF basin, and also for the new alternative access road and temporary and permanent ancillary facilities. These areas contain habitats which are potentially suitable for a number of bird SAR, including Canada warbler and olive-sided flycatcher. This clearing has the potential to result in the direct loss of approximately 40.36 ha of wildlife habitat, and the overlapping direct and indirect loss of 32.69 ha of interior forest from a single patch associated with Forty Mile Brook. Terrestrial wildlife habitat will be permanently lost in the areas which will be flooded to form the new TMF basin. Clearing will remove trees and shrubs within the PDA, and will likely damage understory vegetation. If clearing or excavation occur during the normal breeding season for terrestrial birds (i.e., early April to end of August in New Brunswick; ECCC 2017a), the Project could result in the direct loss of unfledged birds if they are unable to leave their nests. However, clearing will be conducted outside this normal bird breeding season, and the types of habitat that will be affected are abundant in nearby forested areas and no critical habitat for SAR has been designated in the region.

The clearing of vegetation will also result in a change in the quality of habitat along the edge of the PDA through habitat fragmentation and the creation of edge. A change in quality of the habitat along the edge of the PDA due to increased side lighting or drying of what was previously interior forest habitat will occur. Edge effects can also increase access for wildlife herbivores and predators, resulting in changes to indirect mortality through increased predation, and nest parasitism. Small mammal and herptile populations with limited dispersal capabilities are particularly susceptible to edge effects and habitat fragmentation. Populations isolated from other populations in small fragments are more prone to local extirpation since these fragments may be too small to support a population. Fragments which are large enough to support a population may not be large enough to provide enough animals to rebuild a population, should it be heavily affected by disease or predation. Isolation of the fragment can also impair the immigration of new animals into an area where a local population has been extirpated. Impaired immigration can also adversely affect populations by restricting gene flow between populations, leading to inbreeding.

Habitat fragmentation can also affect highly mobile species such as birds. During the breeding season, some species may be reluctant to cross clearings including open water, where predators may be more easily be able to detect or capture them. This can result in populations becoming isolated in resultant habitat fragments.

Construction has the potential to interact with wildlife populations through loss or change of available habitat primarily within the area of the new TMF basin and associated dam. Although the area within the TMF will be cleared prior to physical construction and flooding of facilities, it will provide habitat similar to that of a recent forestry clear-cut. A number of migratory bird species, including common nighthawk (a SAR) are known to make use of such areas for nesting and feeding. The flooding of the TMF basin has the potential to result in the loss of unfledged young of these species without planned avoidance mitigation, if they are using the area as habitat. The flooding of the TMF will result in the loss of this previously cleared (and temporary) habitat, possibly resulting in interaction with other bird or wildlife species if they are using this area prior to flooding. This interaction will be dependent on the timing of flooding. If flooding were to occur within the normal breeding season for these species (i.e., mid-May to end of July in the local ecodistrict; BSC 2018), the Project could result in the direct loss of unfledged birds. However, current plans are to commission the dam and flood the area in Q1 of 2020, prior to the nesting season for ground nesting birds.

Sensory disturbance resulting from light and noise of construction equipment could result in reduced productivity or nest abandonment, which could lead to an indirect change in mortality rates for wildlife species. Some wildlife species may also experience temporary habitat loss via avoidance (Bayne et al. 2008). Increased predation of small mammals or herptiles may occur as they flee cover in response to construction noise.

Collisions between birds and construction equipment could result in a Project-related increase in bird mortality. Lighted equipment can attract birds during migration periods; this phenomenon is most pronounced at night and in poor weather conditions (Avery *et. Al* 1976; Longcore and Rich 2004; Ogden 1996; Wiese *et al.* 2001).

Overall, as noted in Section 5.7.3.1 above, some wildlife habitat within and immediately adjacent to the PDA will necessarily be lost as part of the Project to make way for the new TMF and associated infrastructure. However, there are no known occurrences of wildlife SAR within the PDA and, subject to confirmation, the habitat in the PDA is not unique and is readily abundant in the ecoregions, and the PDA does not contain critical habitat for SAR. No direct mortality of SAR due to the Project is expected with planned mitigation. The potential interactions between the Project and wildlife and wildlife habitat will be mitigated through the use of mitigation listed in Section 5.8.3.4. With the implementation of mitigation, the potential interactions between the Project and wildlife and wildlife habitat during construction is not expected to be substantive on the local, regional, or provincial scale.

5.8.3.2 Operation Phase

Operation activities have the potential to result in adverse environmental interactions with wildlife and wildlife habitat, which could result in changes to wildlife SAR, SOCC, and wildlife habitat, notably sensory disturbance to wildlife resulting in habitat avoidance.

Though most of the changes to wildlife habitat will occur during the construction phase, operation activities have the potential to result in adverse environmental interactions with wildlife and wildlife activity. Similar to the construction phase, operation activities may also produce sensory disturbance. This sensory disturbance could result in temporary wildlife habitat loss as a result of reduced habitat effectiveness if species avoid the area. Breeding and rearing success for some wildlife species may be affected by sensory disturbance (Bayne *et al*. 2008).

Operation includes the presence of the new TMF basin, which will contain mine contact water which is treated before release. This water may contain an elevated level of metals, and a lower pH. This open body of water may attract breeding or migrating waterfowl or waterbird species. There is, however, no known use of the existing STTP by waterfowl or waterbirds, and it is unlikely that the new TMF basin will be colonized by aquatic vegetation due to the water chemistry and active deposition of tailings. There are natural bodies of water in the general area that provide higher quality waterfowl/waterbird habitat. Since there is no likely food source in the TMF, it is unlikely that the new TMF basin will provide appropriate breeding or feeding habitat for waterfowl, and so no substantial interaction is predicted.

The Project is not within a known migration pathway (USFWS 2018); however, there is still potential that some migrating birds may pass through the area. Nocturnal migrants (*i.e.*, most passerines) are generally high-flyers and are not at risk of suffering collision with Project infrastructure in flight. Diurnal migrants, including waterfowl, waterbirds, and raptors, have more variable flight, and could potentially interact with Project infrastructure.

Overall, the operation of the Project is not expected to result in further physical disturbance of wildlife habitat that did not already occur during construction, but may result in some sensory disturbance to wildlife populations and possible avoidance of the area. Substantive interactions between the Project and wildlife and wildlife habitat during operation is not expected.

5.8.3.3 Closure/Post-Closure Phase

Interactions between wildlife and wildlife habitat and the closure phase of the Project (i.e., Stage 2 construction) are anticipated to be similar to construction of the Stage 1 PDA, as described above, with an additional loss of 94.99 ha of wildlife habitat, and the overlapping direct and indirect loss 50.5 ha of interior forest associated with three patches, including the loss of a 13.4 ha patch. Limited changes are anticipated following the operation phase, and the TMF dam and polishing pond will remain in operation in perpetuity.

Similar to the construction and operation phases, closure activities may also produce sensory disturbance. This sensory disturbance could result in temporary wildlife habitat loss as a result of reduced habitat effectiveness if species avoid the area.

The dismantling and removal/disposal of associated TMF surface infrastructure (e.g., pumphouse, roads, pipelines, etc.) will not be assessed as part of this study and will be further assessed during the mine closure stage as part of the permitting and EIA approval process required at that time. Generally, surface infrastructure will either be removed from the property or disposed on-site depending upon the nature of the material. Efforts will be made to sell and/or recycle materials in an approved facility. Grading and/or scarification or disturbed areas to promote natural vegetation or placement and grading of overburden for vegetation in areas where natural vegetation is not sufficiently rapid to control erosion and sedimentation. Generally, it is anticipated that this will result in a positive interaction with wildlife and wildlife habitat, providing some opportunity for vegetation to re-establish and act as wildlife habitat over time.

5.8.3.4 Mitigation for Wildlife and Wildlife Habitat

The following well-established practices to reduce the interaction between the Project and wildlife and wildlife habitat will be implemented during the various phases of the Project, as applicable.

- Conduct confirmatory field work in the Stage 1 PDA (spring-summer 2018) and Stage 2 PDA (later, prior to any construction for Stage 2) to confirm the presence or absence of bird SAR and SOCC.
- Conduct a basking survey for turtles in the affected reaches of Forty Mile Brook in spring-summer 2018, in conjunction with other field surveys, to determine the potential presence of wood turtle or common snapping turtle.
- Record incidental observations of wildlife during targeted field surveys.
- Avoid, to the extent feasible, known locations of wildlife SAR and SOCC.
- Avoid construction, particularly clearing and flooding activities, in areas of native vegetation during the normal breeding season for migratory birds (April 15 to August 31).
- Locating linear facilities within existing right-of-ways adjacent to other linear facilities, where possible, to minimize fragmentation and creation of edge.
- Establishment of buffers and protection of active migratory bird nests until fledging, upon their discovery in work areas during construction.
- Use approved noise arrest mufflers on equipment to reduce potential environmental effects of noise.
- Use full cut-off lighting during construction to reduce attraction to migrating birds.
- Operate vehicles and equipment on previously disturbed areas, wherever feasible.

- Limit size of temporary workspaces; use previously disturbed areas or areas to be flooded rather than natural areas outside the TMF PDA.
- Properly store and dispose of construction site wastes that might attract wildlife.
- Allow for natural regeneration when possible, and when not possible, use a native seed mix for revegetation, progressively during operation and at closure.
- Restore temporarily disturbed areas to pre-construction conditions.
- Rehabilitate access routes that are no longer needed.

The mitigation described above will limit the reduction of wildlife habitat, including wetlands, and will also reduce the potential for wildlife mortality that might be caused by the Project. Some loss of wildlife habitat is unavoidable if the Project is to proceed; while not planned, it is possible that some mortality of wildlife could occur, but the mitigation will reduce potential interactions with the wildlife and wildlife habitat. Habitat for wildlife species will remain available in the surrounding landscape.

5.8.4 Follow-Up for Wildlife and Wildlife Habitat

Follow-up work for this assessment of the environmental effects on wildlife and wildlife habitat will include conducting and analyzing field surveys for breeding birds to be conducted within the Stage 1 PDA and surrounding LAA in the spring and summer of 2018, as noted in the subsections that follow. A targeted basking survey for turtles will also be conducted in the reaches of Forty Mile Brook that will ultimately be covered by Project components. Incidental observations of other wildlife noted during these and other surveys will be recorded, including the presence of bat hibernacula or milkweed, should any be noted during the surveys. Prior to field surveys, a GIS-based analysis of forest habitats present in the PDA and LAA will be conducted using data available from NBDNR's forest inventory database (Geographic Information Systems Section), supplemented with recent harvest information. This analysis will assist the selection of survey stations within the landscape.

The results of these surveys will be provided in a supplemental report, to be submitted to the NBDELG for its review in parallel to the EIA review for the Project. Any conditions observed in the field that might affect the assessment presented in this EIA Registration document will be described in the supplemental report.

5.8.4.1 Early Nesting Species

Surveys targeting early nesting species (e.g., woodpeckers and raptors) were conducted during the spring of 2018. Surveys were conducted in good environmental conditions (i.e., light winds and little to no precipitation), and began after dawn. Area search surveys in forested habitats were conducted in an effort to detect breeding woodpecker and raptor species within the LAA. All species of birds encountered were recorded. Species, number of individuals, and breeding evidence were noted for all birds encountered. Results of these surveys will be evaluated and provided in a supplemental report along with other terrestrial data including results of breeding bird surveys, and vegetation and wetland surveys.

5.8.4.2 Nocturnal Owls

Nocturnal owl surveys were completed in the PDA and surrounding area during spring of 2018, concurrent with early nesting species surveys. Surveys were conducted in accordance with the Guidelines for Nocturnal Owl Monitoring in North America (Takats et al. 2001), and included a two-minute silent listening period followed by a 10-minute period of alternating playbacks and silent listening periods. Surveys began approximately 30 minutes after sunset, and were completed prior to midnight. Survey stations were established along assessable roads, and were located no closer than 2 km from one another. Information including general noise level, environmental conditions, and the presence of other nocturnal wildlife species were recorded. No owl species were encountered during these surveys. Results of these surveys will be evaluated and provided in a supplemental report along with other terrestrial data including results of breeding bird surveys, and vegetation and wetland surveys.

5.8.4.3 Herptiles

Habitat assessments targeting wood turtles will be conducted on the affected reaches of Forty Mile Brook and the associated riparian zones within the PDA. These assessments will take place concurrently with vegetation and wetland assessments in the summer of 2018. The results of the habitat assessment will be used to determine the need for basking surveys. Other incidentally encountered wildlife species (or their sign) will be recorded during these surveys.

5.8.4.4 Forest Breeding Birds

Forest breeding bird surveys were conducted during the month of June in 2018, and consisted of 10-minute point counts, and atlassing surveys throughout the Phase 1 PDA. Point count survey protocol was based on a modified fixed-radius point count sampling procedure (Bibby et al. 2000). Survey stations were visited once, and established within the various habitat types represented within the PDA to obtain survey coverage of each habitat present. Stations were no closer than 300 m apart, and were greater than 100 m from edges of other habitat types, where possible. Survey days began near dawn, and in suitable environmental conditions (i.e., light winds, and little to no precipitation), and continued until approximately 10:00 am. Incidentally encountered wildlife species (or their sign) werel recorded during these surveys, and will be recorded during other surveys such as vegetation and wetland surveys. Results of these surveys will be evaluated and provided in a supplemental report along with other terrestrial data including results of breeding bird surveys, and vegetation and wetland surveys.

5.8.4.5 Waterfowl and Waterbirds

Surveyors visited the current TMF in May 2018, during early nesting species surveys, and again in June 2018 during breeding bird surveys. The TMF was visually observed for the presence of waterfowl, however no waterfowl or waterbird species were observed during either survey.

5.8.4.6 Species at Risk

Prior to field surveys, a GIS-based analysis of forest habitats present in the LAA were conducted to identify habitats which have the potential to contain the bird SAR identified by the AC CDC and MBBA, and those identified as possibly present due to the presence of suitable habitat (i.e. olive-sided flycatcher, eastern wood-pewee, and rusty blackbird). Survey transects were established along these habitats within the Phase 1 PDA. Surveyors conducted atlassing surveys along the survey transects, in an effort to determine the presence of the target SAR. Playbacks were occasionally used where no SAR were identified in areas which were deemed to be high potential in an attempt to elicit a response from the target species. Results of these surveys will be evaluated and provided in a supplemental report along with other terrestrial data including results of breeding bird surveys, and vegetation and wetland surveys.

5.8.5 Summary for Wildlife and Wildlife Habitat

Construction activities for Stage 1 are expected to result in the loss of approximately 40.36 ha of wildlife habitat (i.e., forested upland and wetlands) which will require clearing within the footprints of the Stage 1 TMF, and temporary and permanent ancillary facilities including buildings and roadways. With mitigation, the construction of the Project is not expected to interact directly with SAR or SOCC, but will result in adverse changes to habitat for potential SAR or SOCC within the PDA, and potential indirect effects in the LAA, outside the PDA. These changes will occur in a single event and will not be reversed following construction.

During operation, there is potential for the Project presence and maintenance to result in ongoing habitat and edge influences and sensory disturbance within the PDA. These areas will have been previously disturbed during construction. With mitigation, this activity will result in low adverse changes, restricted to the PDA.

Closure activities associated with the construction of the Stage 2 PDA will be similar to construction of the Stage 1 PDA, resulting in the direct loss of 94.99 ha of wildlife habitat. These changes will occur in a single event, and will not be reversed following closure/post closure. The dismantling and removal/disposal of associated TMF surface infrastructures (pumphouse, roads, pipelines, etc.) have not been assessed as part of this study and will be further assessed during the mine closure stage.

In light of the above, and in consideration of the nature of the potential interactions between the Project and wildlife and wildlife habitat, as well as proposed mitigation, the Project is not expected to result in a substantive interaction with wildlife and wildlife habitat during all phases.

5.9 ASSESSMENT OF POTENTIAL INTERACTIONS WITH HERITAGE RESOURCES

This section presents the assessment of potential` interactions between the Project and heritage resources that may be present within the PDA. Heritage resources has been selected as a VC in recognition of the interest of: provincial and federal regulatory agencies who are responsible for the effective management of these resources; the scientific community; and the interest that First Nations and the public have in the preservation and management of heritage resources related to their history and culture.

5.9.1 Scope of Assessment

For this VC, heritage resources include consideration of historical, archaeological, built heritage, and palaeontological resources. Heritage resources will focus on archaeological resources (consisting of Indigenous and Euro-Canadian archaeological sites), built heritage (historical buildings and structures), and palaeontological resources (fossil sites), as all resources that will be understood to be “historical” are captured under one of these heritage resource types.

Heritage resources are resources that result from human activities and those of other living organisms (i.e., fossils) from the past that remain to inform present and future societies of that past. Heritage resources are permanent, although highly tenuous, features of the environment. If heritage resources are present, their integrity is highly susceptible to construction and ground-disturbing activities. The value of heritage resource sites is measured in terms of the information about the past that might be obtained from studying the materials that remain and, where applicable, their spatial relationship and context within the site and landscape. These resources are particularly susceptible to disturbance in terms of losing information that comes from their context on and in the ground. As a result, removing or disturbing these resources from an *in situ* context without scientifically recording that original context can result in a permanent loss of information, as in many cases these resources are the only means society has of learning about this past.

Any Project activity that includes surface or sub-surface ground disturbance has the potential for interaction with heritage resources, when present. Accordingly, construction represents the greatest potential for interaction with heritage resources, as it is during construction that the majority of the ground breaking and earth moving activities of surface soils will take place to construct Project components.

Heritage resources in New Brunswick are regulated under the *Heritage Conservation Act*. The regulatory management of heritage resources falls under the New Brunswick Department of Tourism, Heritage, and Culture (NBDTHC), and is administered by its Archaeological Services Branch (for archaeological resources), Historic Places Section (for built heritage resources), and Natural Sciences Section (for palaeontological resources).

The review for heritage resources has been undertaken through the completion of historical, archaeological, built heritage, and palaeontological research. The Province of New Brunswick provides guidance for conducting archaeological impact assessments (e.g., *Guidelines and Procedures for Conducting Professional Archaeological Assessments in New Brunswick* [the “Archaeological Guidelines”; Archaeological Services 2012]), combined with consultation with the regulatory agencies being undertaken upon the identification of any heritage resources.

Consultation and engagement activities have been initiated as part of the assessment of potential interactions with heritage resources and the Project. During the background research for heritage resources, regional experts and regulatory agencies were contacted in order to gather information on potential heritage resources within the PDA (Table 5.18).

Table 5.18 Experts Consulted as Part of Engagement Activities for Heritage Resources

Name of Expert	Affiliation
Tricia Jarratt	Manager, Archaeological Services Branch
Dr. Randall Miller	Curator, Geologist, New Brunswick Museum

TMNBL has initiated First Nations engagement for the Project. As the engagement process progresses, areas of interest regarding heritage resources within the PDA identified by First Nations representatives, will be taken into consideration during the planning stage of the Project. Mitigation will be developed, as warranted, in consultation with regulatory agencies, and First Nations, as applicable. First Nations will be invited to participate in field work undertaken for the archaeological impact assessment for the Project.

A request was made to staff at the Archaeological Services Branch for information on documented heritage resources from the Archaeological Services Sites Database. This consultation involved requesting and reviewing the provincial archaeological potential maps and map data to identify known archaeological sites and heritage resources in the area of the Project, identifying any potential palaeo-shorelines, and areas of elevated archaeological potential interacting with the PDA (T. Jarratt, pers. comm., February 15, 2018). An Archaeological Field Research Permit (AFRP) application, detailing the methodology to be employed in the Archaeological Impact Assessment for the Project, will be submitted to, and approved by, Archaeological Services prior to initiating the archaeological impact assessment.

Consultation has occurred with Dr. Randall Miller, Curator at the New Brunswick Museum, to discuss any concerns with respect to palaeontological resources (i.e., fossils). Dr. Miller noted that there are no known fossil occurrences within the PDA; however, there are geological formations present within the PDA that have the potential to contain palaeontological resources (Miller 2018).

The PDA was described in Section 2.2. The LAA is defined as the maximum area where Project-specific environmental interactions can be predicted and measured with a reasonable degree of accuracy and confidence. For heritage resources, the LAA is limited to the PDA. The temporal boundaries were described in Section 5.1.3.

5.9.2 Existing Conditions for Heritage Resources

Archaeological resources, built heritage, and palaeontological resources were considered when describing existing conditions as part of this VC.

5.9.2.1 Archaeological Resources

A search of the Archaeological Services report database and project manuscript files was conducted on February 15, 2018 and identified a list of archaeological projects on file at the Archaeological Services Branch for projects and research conducted in the region within which the PDA is located. While no professional archaeological assessments have previously taken place within the PDA specifically, several assessments have been undertaken in the surrounding area (Buchanan 2017; Allen 2000; Allen 2003; Bishop 1982; Jeandron 2004; Jeandron 2009; Manny 1963; Stantec 2010; Suttie 2007; and Washburn & Gillis Associates Ltd. 1991). Where relevant, information provided by these archaeological assessments is presented in the sections below.

Pre-Contact Period

The Pre-contact period is defined as the period of human occupation of the lands of eastern Canada for the entirety of the timeframe from the first arrival of humans, approximately 11,500 years Before Present (BP), up to the time of contact between these Indigenous populations, and the European explorers when they first encountered North America, generally interpreted to be approximately 500 years BP.

A review of the Archaeological Potential Map for the Project indicated that there are no registered Pre-contact Period archaeological sites located inside, or within 10 km of the PDA (Figure 5.14). However, this may be more of a reflection of the lack of archaeological surveys having been completed in this area than a statement about use of this area during Pre-contact times.

Archaeological evidence from Debert, Nova Scotia, and Pennfield, New Brunswick, indicates that the first peoples to inhabit what is now the southern portion of modern day New Brunswick likely arrived in that region at the end of the Pleistocene (McMillan and Yellowhorn 2004; Suttie et al. 2013), approximately 11,000 years BP. Much of what is now northern New Brunswick would have remained under glacial ice sheets until around 10,600 BP, when the initial Wisconsinan deglaciation during the Allerød warm period began. However, due to the dynamic nature of the environment, with such events as the Younger Dryas ice re-advance, followed by another deglaciation, much of this area will likely not have been suitable for human occupation until after about 9,000 years BP (Bonnichsen et al. 1985; Cwyner et al. 1994; Seaman 2006). As was the case throughout what is now Canada, as the glaciers melted, human populations moved into each area as soon as climatic and subsistence conditions allowed and there is evidence of the permanent human occupation of what is now northern New Brunswick, such as the villages found at Metepenagiag, near Miramichi, dating back several thousand years.

The PDA lies within the traditional territory of the Indigenous people of the Mi'gmaq First Nation, specifically the Gespe'g (Gespegeog) District (NBDNR 2007; Mi'gmaq-Mi'kmaq Online 2018). Artifacts recovered from archaeological sites along coastal areas and nearby Mount Carleton Provincial Park show evidence of Indigenous occupation through the region for at least the last 3,000 years (NBDNR 2007; High County Research and Development 1972), and artifacts potentially dating to the Palaeo-Indian period have been identified as close as Stonehaven, approximately 50 km northwest of the Caribou mine location (Stantec 2010).

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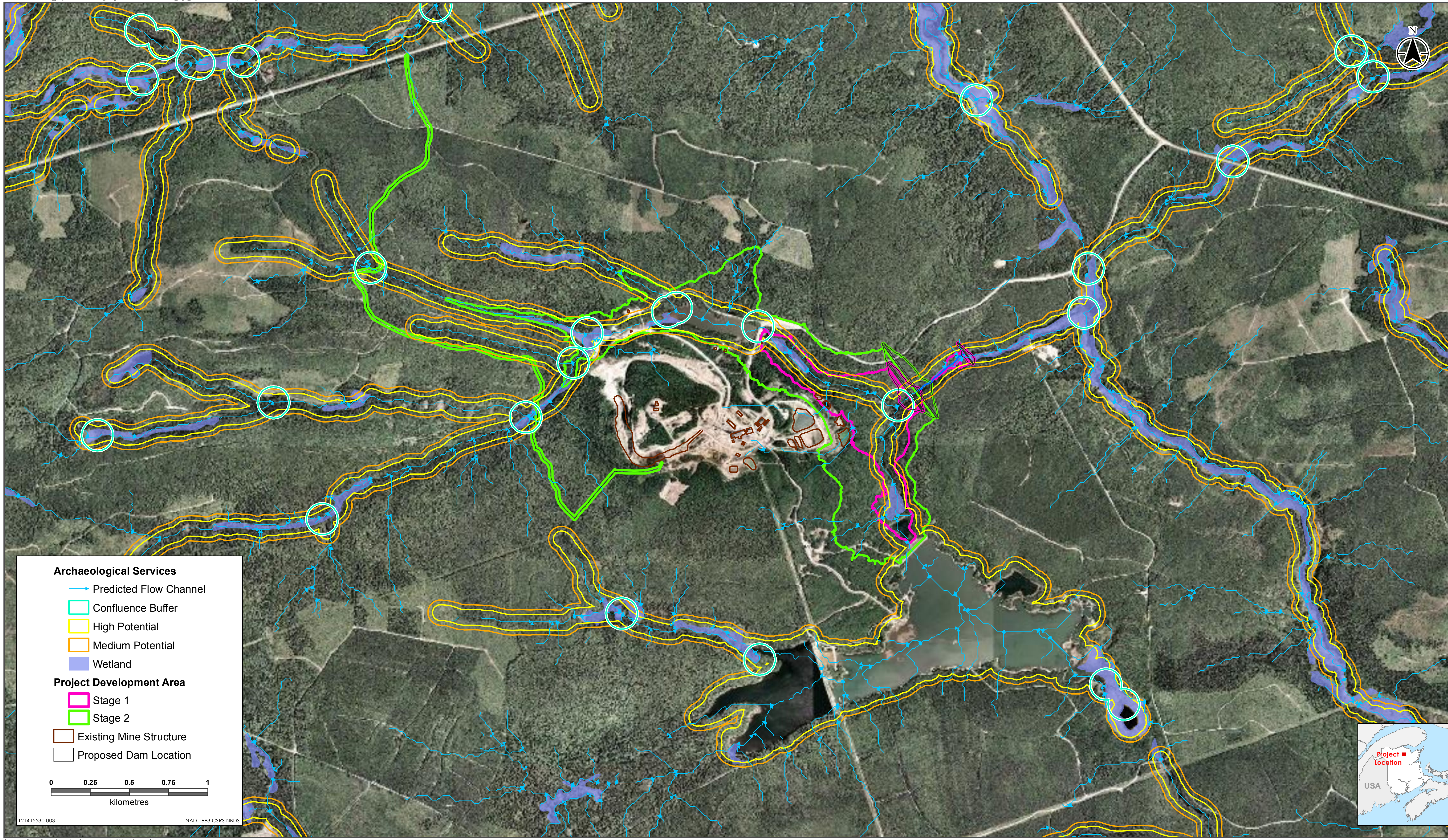

Sources: Base Data from the Government of New Brunswick
Service Layer Credits: Service New Brunswick/Service Nouveau Brunswick

Archaeological Features within and in the vicinity of the Caribou Project Area

Stantec

121415530 - TREVALI MINING (NEW BRUNSWICK) LTD.

Figure 5.14

Historic Period

The Historic Period is defined as the period from the arrival of mostly European derived peoples to North America, approximately 500 years ago, until the modern era.

A review of the Archaeological Potential Map for the Project (Archaeological Services 2018) indicated that there are no registered Historic Period archaeological sites located inside, or within 10 km of, the PDA.

In terms of the Historic Period occupation of the general area of the PDA, early French explorers began visiting and occupying coastal areas to the north in the late 17th Century (NBDNR 2007). European immigrants begin moving inland from the coast in the early 19th Century following the establishment of Crown forest leases in nearby Balmoral Parish (NBDNR 2007; Rayburn 1975). Most settled in temporary lumber camps along the margins of larger river systems like the Nepisiguit, Northwest Miramichi, and Tetagouche Rivers as a means of accessing timber resources (NBDNR 2007; NBPA 2018; Rayburn 1975). The terrain throughout this area contains mineral deposits of base and precious metal, many of which occur in the volcanic lithologies of the Tetagouche Group (NBDNR 2007). The existing Caribou mine site has been developed and mined by several different entities over the years, beginning in 1954 and continuing until today. Other mineral resource developments have also been undertaken in the surrounding areas (SRK 2013).

No evidence was found to indicate Historic Period use or occupation of the PDA, prior to the mining developments.

5.9.2.2 Built Heritage

A search of the Canadian Register of Historic Places (CRHP 2018) and the New Brunswick Register of Historic Places (NBRHP 2018) indicated there are no registered historic places or heritage sites located within or near the PDA.

5.9.2.3 Palaeontological Resources

A palaeontological report based on known data sources within the PDA was prepared by Dr. Randall Miller with the New Brunswick Museum (Miller 2018). The report noted that while the geological formations along the PDA consist almost exclusively of extrusive igneous rock, formations of sedimentary rock from the Boucher Brook Group are also present. In general, this group is comprised of thin-bedded graphitic shale, siltstone, sandstone, and pods of limestone within the basalt. The report states that there are no known fossil localities located within the PDA; however, there are several documented fossils sites located within the Boucher Brook Group approximately 3 km west of the PDA. These fossils were identified in limestone deposits and include graptolites and trilobites, as well as microfossils such as conodonts. If suspected fossils are discovered within the PDA, the *Heritage Conservation Act* requires that those finds be reported to the New Brunswick Museum, and a permit may be required to collect any identified fossils (Miller 2018).

5.9.3 Assessment of Potential Environmental Interactions with Heritage Resources

This section describes how the Project activities could interact with heritage resources as well as the techniques and practices that will be applied to mitigate these potential interactions. This includes both Stage 1 (construction) and Stage 2 (closure).

5.9.3.1 Construction Phase

There are two aspects to the potential interaction of Stage 1 with heritage resources: 1) construction and associated activities for the development of the TMF; and 2) the flooding of tailings basin within the TMF dam for Stage 1.

During Stage 1 construction, activities that could result in a potential interaction with heritage resources include site preparation and excavation. Archaeological resources, where present, are typically located in the upper soil layers of the earth and therefore potential interactions between these resources and the Project could take place during construction.

Vegetation clearing for the Project will largely be carried out by mechanical means and while it is possible for some ground disturbance (i.e., rutting) during this phase, it is anticipated that ground disturbance will be minimal. Ground breaking and earth moving activities will be limited to the areas where excavations are carried out to construct the new Project components including: the Stage 1 TMF dam, polishing pond and dam, TMF basin, water treatment facility, reclaim pumphouse, and tailings deposition pipeline. Any potentially adverse interactions with heritage resources that might occur due to construction activities will be permanent, as no archaeological site or fossil can be returned to the ground in its original state.

For any new access and where staging areas are located, ground disturbance is usually required where the ground surface areas are prepared for use (e.g., grading and removing topsoil), and thus may result in a potential interaction with subsurface heritage resources that might be present. Any mechanical auguring, excavation, or blasting that occurs during this stage has the potential to interact with heritage resources.

While no construction-related activities other than the clearing of trees and vegetation in the locations outside of the direct construction areas are planned for the flooding stage of the TMF, the creation of the tailings pond will effectively eliminate all areas within the tailings basin from ever again being accessible for archaeological research. Therefore, for the purposes of the assessment of construction, the footprint for the Stage 1 TMF is considered to potentially interact with heritage resources, and this area will be subject to the AIA in 2018 to determine if any subsurface heritage resources are present prior to initiating construction, in accordance with the Archaeological Guidelines (Archaeological Services 2012).

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

- Completion of an archaeological impact assessment (AIA) including a walkover survey of the Stage 1 PDA for the Project to identify areas of elevated potential for archaeological resources within the PDA.

- Implement appropriate mitigation such as shovel testing in areas identified as having elevated potential for archaeological resources (as determined by the walkover survey conducted as part of the AIA) that will be directly affected by construction activities or indirectly affected by flooding of the TMF.
- Should any heritage resources be identified that could be affected by the Project, additional mitigation, as required, will be developed in consultation with provincial regulators (e.g. Archaeological Services Branch or the New Brunswick Museum) and First Nations, as applicable.
- Implement archaeological monitoring during construction activities in areas of elevated archaeological potential where shovel testing is not practicable.
- A heritage resource discovery contingency plan will be included in the environmental management plan in the event that heritage resources, such as archaeological or fossil sites, are encountered during construction activities.

5.9.3.2 Operation Phase

During operation, it is anticipated that there will be no interaction with heritage resources. All mitigation for heritage resources will be implemented prior to the construction of the Project.

5.9.3.3 Closure/Post-Closure Phase

It is anticipated that closure of the facility will be assessed under a separate EIA registration. It is further anticipated that an archaeological impact assessment (AIA) for the closure activities will be required prior to construction of Stage 2 including the expanded TMF and the new alternative access road. It will be vital that sufficient time be allowed for the implementation of the Stage 2 AIA as well as a buffer of time in order to implement any further mitigation (such as shovel testing) in the event that areas of elevated archaeological potential are identified and if any heritage resources are discovered during the Stage 2 shovel testing.

With the implementation of mitigation resulting from a future AIA, anticipated to be similar to the mitigation measures recommended for construction, it is not anticipated that the closure stage of the Project will adversely affect heritage resources.

5.9.4 Summary for Heritage Resources

In consideration of the implementation of known and proven mitigation for the identification of heritage resources within the PDA for the Project, and with the development and implementation of appropriate mitigation in the event that heritage resources are discovered within the PDA, the potential for the interaction between the Project and heritage resources is considered low.

5.10 ASSESSMENT OF POTENTIAL EFFECTS OF THE ENVIRONMENT ON THE PROJECT

5.10.1 Scope of the Assessment

Effects of the environment on the Project are associated with risks of natural hazards and influences of nature on the Project. Potential effects of the environment relevant to conditions potentially found in New Brunswick include:

- Climate and climate change considerations, including severe weather as measured by parameters including air temperature, precipitation, winds, and extreme weather events (e.g., tornadoes, ice storms);
- Flooding;
- Forest fires from causes other than the Project; and
- Seismic activity.

These natural forces may result in the following effects of the environment on the Project:

- Reduced visibility and inability to maneuver construction equipment;
- Delays in receipt of construction materials or in carrying out construction activities;
- Increased structural loading;
- Changes to the ability of workers to access the site (e.g., if a road were to wash out);
- Damage to infrastructure; and/or
- Corrosion of exposed oxidizing metal surfaces and structures, perhaps weakening structures and potentially leading to equipment malfunctions.

Potential effects of the environment on any project are typically addressed through design and operational procedures developed in consideration of expected normal and extreme environmental conditions. Effects of the environment, if unanticipated or unmanaged, could result in adverse changes to Project components, the schedules for construction or operation, or its economic viability.

It is recognized that climate change may directly or indirectly influence weather, flooding, and forest fires. The approach in this assessment is to consider climate and climate change as these may influence severe weather, and then specifically consider the potential for flooding and forest fires to affect the Project, in separate but related sub-sections. Seismic events are also considered separately based on the seismic characteristics of the area and design features of the Project aimed at withstanding seismic events.

The spatial boundaries for the assessment of effects of the environment on the Project are limited to the PDA, as the potential area of physical disturbance associated with the construction and operation of the Project, as defined in Section 2.2.

Temporal boundaries identify when a potential environmental interaction is assessed in relation to specific Project phases and activities. The temporal boundaries for the assessment of the potential environmental interactions with the Project, are as defined in Section 5.1.3.

5.10.2 Existing Conditions for Effects of the Environment on the Project

Existing conditions are described for climate (including weather), seismic history, and forest fire activity. Climate change is discussed in Section 5.10.3.1.

5.10.2.1 Climate

Climate is defined as the statistical average (mean and variability) of weather conditions over a substantial period of time (typically 30 years), accounting for the variability of weather during that period. Climate change (discussed in Section 5.10.3.1) is an acknowledged change in climate that has been documented over two or more periods, each with a minimum of 30 years (Catto 2006). The relevant metrics used to characterize climate are most often surface weather variables such as temperature, precipitation, and wind, and others such as storm frequency.

The current climate conditions are generally described by the most recent 30-year period (1981 to 2010) for which the Government of Canada (GOC 2018) has developed statistical summaries, referred to as climate normals. The closest weather station to the Project with available historic data is the Bathurst weather station, located approximately 47 km east of the Project. Selected data from the most recent climate normals were provided in Table 4.1 and are briefly summarized below.

Air Temperature and Precipitation

Based on the climate normals, the average daily temperature at the Bathurst weather station during the period of record ranged between -10.8°C (January) and 19.1°C (July) (Table 4.1). The extreme maximum temperature for the period of record was 37.4°C (June 2003) and the extreme minimum temperature was -35.6°C (January 1994).

Bathurst averaged 1,110.1 mm of precipitation per year during the period of record, of which approximately 795.4 mm fell as rain and 333.5 cm as snow. Extreme daily precipitation at Bathurst station ranged from 33.2 mm (February 2008) to 96.3 mm (October 2008). On average, there have been 5.8 days each year with rainfall greater than 25 mm, and snowfalls greater than 25 cm occurred on average 1.8 days per year (GOC 2018).

Winds

Limited wind data are available for the Bathurst weather station. Maximum hourly wind speeds measured at the Bathurst weather station ranged from 61 km/h to 111 km/h, while maximum gusts for the same period ranged from 56 km/h to 87 km/h (Figure 5.15, GOC 2018).

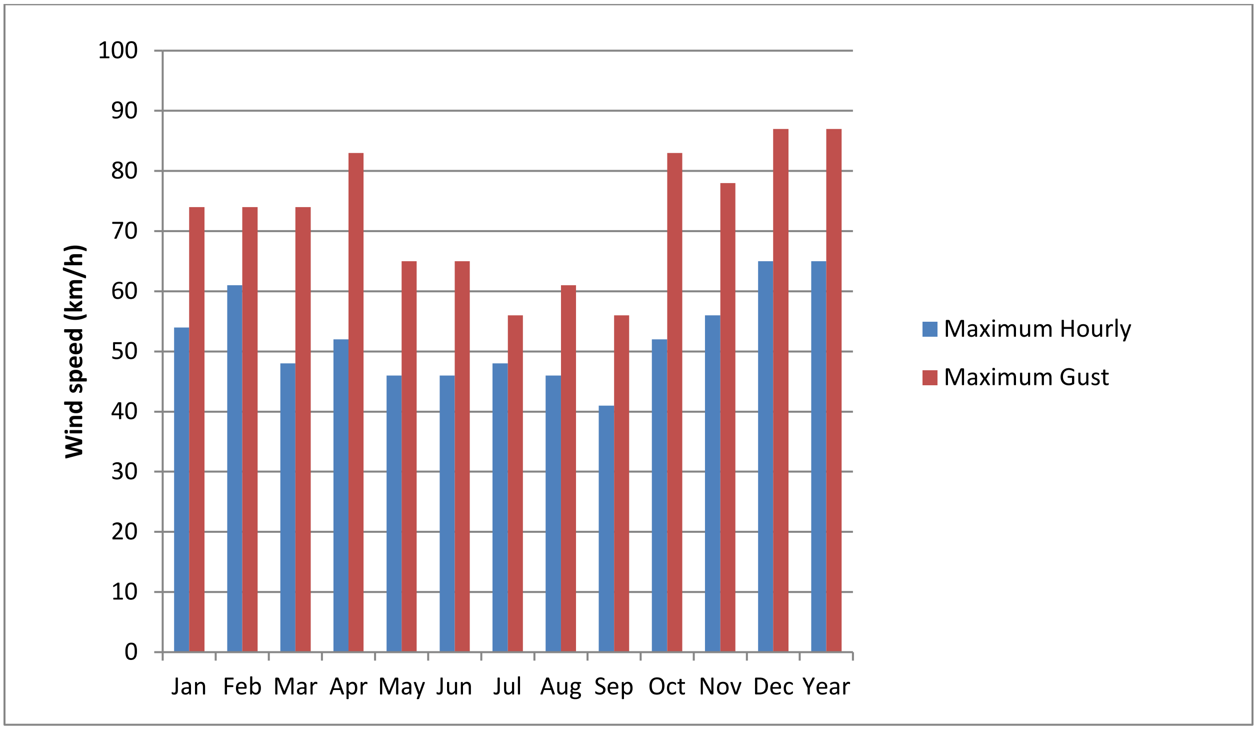

Figure 5.15 Maximum Hourly and Maximum Gust Wind Speeds (1981 to 2010) at Bathurst, New Brunswick Station

Extreme Storms

To establish existing conditions related to extreme storms, some of the most notable storms in the history of the province are described. Though most of these storms did not affect the Restigouche County area directly, they are provided to establish context and to provide examples of extreme storm events in New Brunswick.

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 combination of snow and rain (Phillips 1990).

In February 2003, New Brunswick had an ice storm that brought 40 to 60 mm of freezing rain, followed by cold temperatures and gusting wind more than 75 km/h, generating a wind chill of -27°C. Power lines and trees accumulated up to 33 mm of ice, and 60,000 people were without power for a week (The Weather Network, April 23, 2014).

In January 2017, a freezing rain storm left more than 130,000 people without power, broke approximately 600 transmission/distribution poles in the Acadian peninsula of New Brunswick (NB Power 2017), and sustained weather and ice cover made restoration of power difficult (CBC News, January 25 and 27, 2017). NB Power has estimated the cost of the restoration to be approximately $30 million, and says this is the largest, most expensive restoration effort in its history (CBC News, April 2, 2017).

Extreme weather can also occur in the summer and fall. In July 2014, New Brunswick experienced widespread power disruption when post-tropical storm Arthur brought high winds and intense rainfall over two days, damaging tens of thousands of trees across the province and knocking out power to more than 195,000 NB Power customers at its peak (CBC News, January 25, 2017; GNB 2015). Winds recorded at the Fredericton Airport were 100 km/h with rainfall of 120-145 mm (GNB 2014). Widespread tree damage and damage to the electrical grid occurred from winds gusting to hurricane-force levels, with trees being snapped off and uprooted since they were in full leaf. Southern New Brunswick was hardest hit (ECCC 2015).

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 (Phillips 1990). 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 (Phillips 1990).

Tornadoes are rare but do occur in New Brunswick. There have been 36 confirmed and probable tornadoes in Atlantic Canada between 1980 and 2009: of these, four F2[1], thirteen F1, and three F0 occurred in New Brunswick (GOC 2016). Of Canada's ten worst tornadoes on record, an F2 tornado occurred in eastern New Brunswick at Bouctouche on August 6, 1879 (GOC 2016). In August 1989, three tornadoes touched down in New Brunswick, with one destroying a barn and uprooting some trees in Carlisle. In July 1995, a tornado in Fredericton blew the roof off a government building and damaged an indoor tennis court, and in July 1997, farmers' fields were damaged by a tornado in Grand Falls (The Weather Network 2013).

5.10.2.2 Flooding

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 2015). Flooding in New Brunswick is rather common, especially along the Saint John River (Phillips 1990, Beltaos and Burrell 2000).

Evidence suggests that approximately one-third of flooding events in New Brunswick are caused by ice jams (Beltaos and Burrell 2000). Ice Jams form in rivers during the freeze up and breakup periods, when moving ice floes are stopped by congestion or obstacles, they pose a major threat to riverside communities. Break up ice jams can result in extreme events that cause flooding, damage to property and infrastructure and inhibit hydropower generation (Beltaos and Burrell 2000).

While floods can happen at any time, they are most common during the spring freshet, and can be costly in terms of damage to infrastructure. A search of the Flood History Database maintained by NBDELG (2012) returned multiple historical records associated with flooding in the Bathurst region, with the top event (1987) resulting in approximately $30,000,000 in damage. The database did not return any records near the Caribou mine property.

5.10.2.3 Forest Fire

The Fire Weather Index is a component of the Canadian Forest Fire Weather Index System. It is a numeric rating of fire intensity. It combines the Initial Spread Index and the Buildup Index, and is a general index of fire danger

[1] Tornadoes are classified on a scale known as the Fujita scale. F2 Tornadoes have winds ranging between 180 to 240 km/h. F1 Tornadoes have winds ranging between 120-170 km/h. F0 Tornadoes have winds ranging between 60 to 110 km/h (GOC 2013).

throughout the forested areas of Canada. Fire Weather Normals represent the average value of a fire weather code or index over the 30-year period from 1981 to 2010 (NRCan 2018).

The mean Fire Weather Index for the Restigouche County for years 1981 to 2010 for July (i.e., normally the driest month of the year, when risk of forest fire is typically the greatest) is rated from 0 to 5 (Figure 5.16); this is in the lower range of possible risk (NRCan 2018).

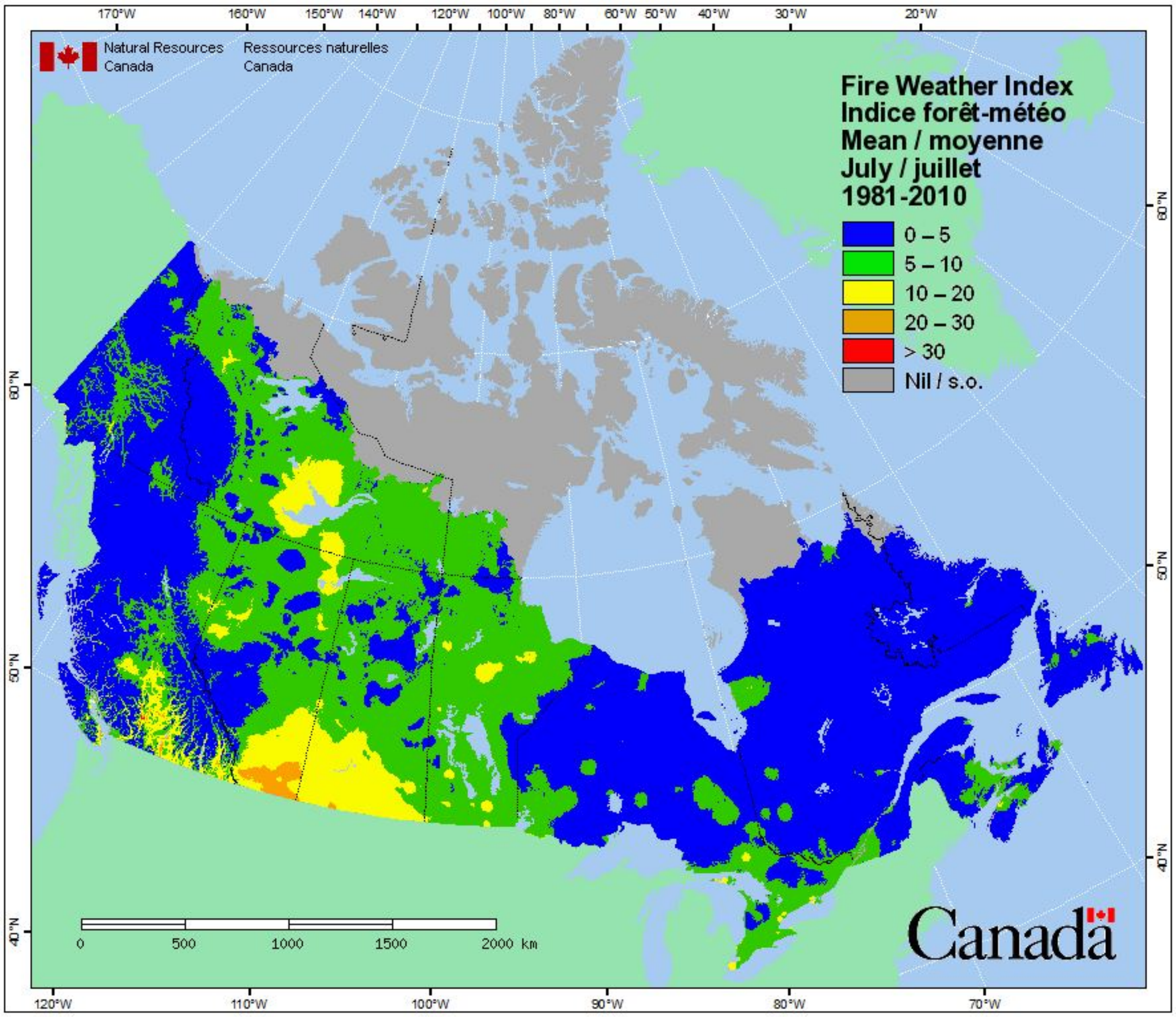

Figure 5.16 Average Fire Weather Index for the Month of July (1981-2010) (from NRCan 2018)

5.10.2.4 Seismic Activity

Seismic activity is dictated by the local geology 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 Caribou mine property is located within the Northern Appalachians seismic zone (Figure 5.17) (NRCan 2016), which includes most of New Brunswick and extends southward into New England. It is one of five seismic zones in southeastern Canada, where the level of historical seismic activity is low. Historical seismic data recorded throughout eastern Canada has identified clusters of earthquake activity. Earthquakes in New Brunswick generally cluster in three regions: the Passamaquoddy Bay region, the Central Highlands (Miramichi) region, and the Moncton region (Burke 2011).

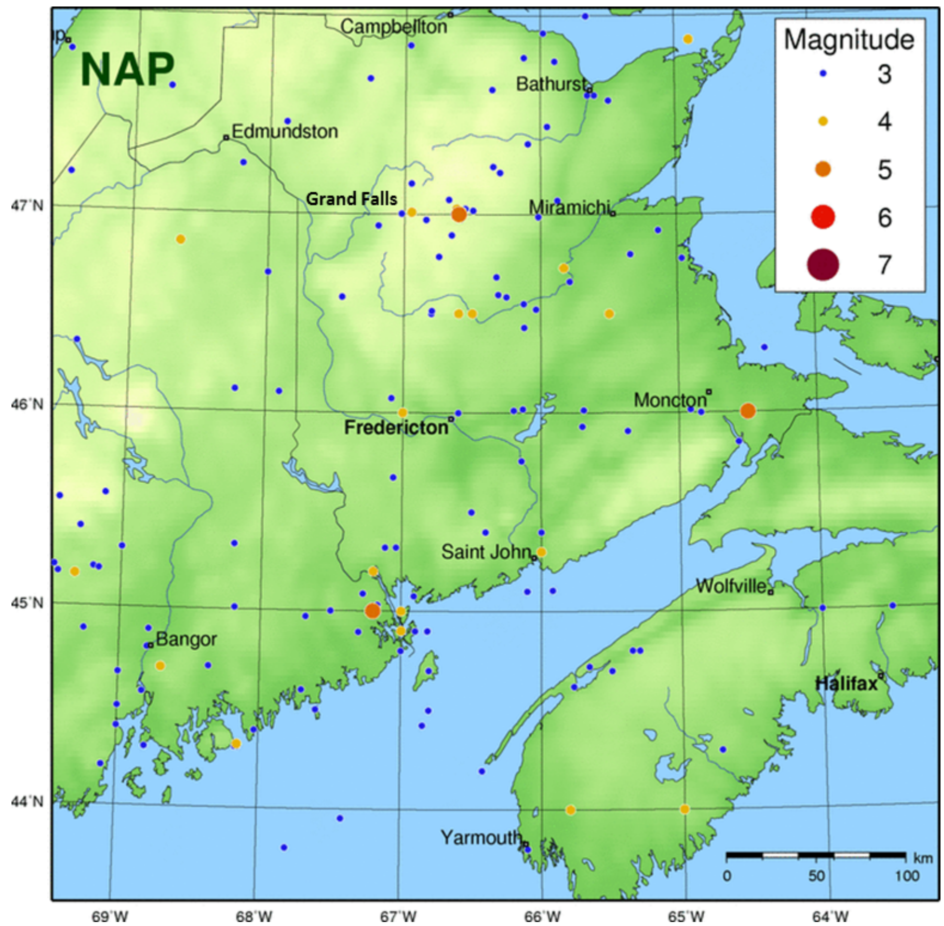

Figure 5.17 Northern Appalachians Seismic Zone (from NRCan 2016)

A review of historical earthquake records and regional tectonics indicates that the Project site is situated in a region of generally low seismicity. The largest earthquake instrumentally recorded in New Brunswick was a magnitude 5.7 event (on the Richter scale) on January 9, 1982, located in the north-central Miramichi Highlands. This earthquake was followed by strong aftershocks of magnitudes 5.1 and 5.4. Prior to 1982, other moderate earthquakes with estimated magnitudes of between 4.5 and 6.0 occurred in 1855, 1869, 1904, 1922, and 1937 (Basham and Adams 1984).

There is potential for earthquakes along the fault zones associated with the St. Lawrence River. However, these events would be located approximately 200 km northwest of the Caribou mine property, and therefore the amplitude of ground motions experienced at the Caribou property will be low due to attenuation over a large distance.

5.10.3 Potential Effects of the Environment on the Project

5.10.3.1 Climate and Climate Change

Severe weather and the potential effects of climate and climate change must be considered during infrastructure development. Extreme temperatures and severe precipitation, winds, and extreme weather events could potentially cause:

- Reduced visibility and inability to manoeuvre equipment;
- Delays in construction/operation activities and delays in receipt of materials;
- Inability of personnel to access the site (e.g., if a road were to wash out);
- Damage to infrastructure; and/or,
- Increased structural loading.

During construction, weather events with extreme low temperatures have the potential to reduce the pliability of construction materials used in Project components (e.g., ancillary facilities) and increase susceptibility to brittle fracture.

Snow and ice have the potential to increase structural loading on the Project components. Extreme snowfall can also affect winter construction activities by causing a delay in construction or a delay in delivery of materials, and resulting in additional effort for snow clearing and removal.

During operation and closure, the PDA could experience heavy rain, snowfall and freezing rain events that are capable of causing an interruption of services for extended periods of time, thus stalling mining operations or increasing structural loading on the Project components.

Reduced visibility due to fog could make manoeuvring of equipment difficult in the early part of the day. Likewise, extreme storm events could cause reduced visibility (due to blowing snow or rain) and interfere with manoeuvring of equipment or transporting materials or staff movements. High winds also have the potential to increase loadings on Project infrastructure and cause possible damage. However, these short delays are anticipated and can often be predicted. Tasks that require precise movements can be scheduled during periods when unfavourable weather conditions are less likely to be experienced.

During electrical storms, fault currents may arise in electrical systems, potentially resulting in danger to personnel and damage to infrastructure. This can occur where Project infrastructure is close to the grounding facilities of electrical transmission line structures, substation, and other facilities that have high fault current-carrying grounding networks. A lightning strike could also ignite a fire (see Section 2.7.6 for a discussion of fire as an accidental event).

The effects of severe weather (including as these may change with a change in climate) will be mitigated through:

- Careful and considered design in accordance with factors of safety, best engineering practice, and adherence with standards and codes (e.g., Canadian Dam Association Guidelines (CDA 2013); Canadian Dam Association Technical Bulletin on the Application of Dam Safety Guidelines to Mining Dams (CDA 2014); Canadian Standards Association standards);
- Engineering design practices that will consider predictions for climate and climate change (e.g., the Public Infrastructure Engineering Vulnerability Committee (PIEVC) "Engineering Protocol for Infrastructure Vulnerability Assessment and Adaptation to a Changing Climate" (PIEVC 2014)); and
- Inspection and maintenance programs that will reduce the deterioration of the infrastructure and will help to maintain compliance with applicable design criteria and reliability of the Project.

Further to responsible design and construction of the Project, and ongoing inspection and maintenance, the selection of materials that are able to withstand temperatures and loads will more than adequately address climate concerns. The selection of materials that withstand potential environmental stressors related to climate will include engineering specifications of the Canadian Standards Association and other construction standards that contain design specific provisions, such as:

- Critical structures that will be constructed with resilient materials to prevent brittle fracture at low ambient temperature conditions; and
- Critical structures that will be constructed to withstand the structural loading expected with high winds and weight associated with ice and snow.

5.10.3.2 Flooding

Flooding and erosion within the PDA have long been a factor of consideration, adaptation, and mitigation for TMNBL. By continuing to develop ongoing adaptive and mitigation strategies, environmental stressors such as flooding will be inherently addressed.

Flooding as a result of dam failure is the most severe potential effect on Forty Mile Brook. A dam failure may be caused by a number of factors including extreme weather, inadequate spillway capacity, seismic events, design error, inadequate quality control during construction, internal erosion, foundation instability, or poor maintenance. The NTTP and polishing pond will be designed, constructed, and operated in accordance to the Canadian Dam Association's dam safety guidelines (CDA 2013; CDA 2014) to reduce risk of failure and subsequent flooding. The selection of appropriate design earthquake and flood events for dams in Canada is based on the dam classification and recommended design values set out by the CDA. The consequence classification for a dam is carried out by considering the potential incremental consequences of a dam failure on human life, infrastructure, and the environment, defined as "***the total damage from an event with dam failure minus the damage that would have resulted from the same event had the dam not failed.***"

NTTP discharge facilities consist of service and emergency spillways at the crest of the embankment, flood conveyance channels to carry flows from the NTTP spillway crest to the Forty Mile Brook downstream of the dam, and energy-dissipation structures to use up energy thus reducing erosional forces before entering Forty Mile Brook. The function of discharge facilities is to prevent overtopping of the dam during a flood event and enhance the safe operation of the NTTP and polishing pond by increasing the range of inflows that can be managed in extreme circumstances. The inflow design flood is the most severe inflow flood (peak, volume, shape, duration, timing) for which a dam and its associated discharge facilities are designed (CDA 2014). In addition, freeboard or the distance between the still pool reservoir level and the crest of the containing structure will be designed to satisfy requirements of the CDA based on the selected dam classification to protect the structure from overtopping by flood events and/or by wind induced waves.

The invert elevation of associated spillways will be based on the environmental design flood on top of the normal operating water level. The environmental design flood is the most severe flood that is to be managed without release of untreated water to the environment (20013). Water stored in the NTTP up to this environmental design flood level will be treated in the water treatment plant, rather than discharged untreated through the spillways. The environmental design flood volume will be designed for effluent water quality to meet applicable discharge limits during a flood event. In addition, process water will be reclaimed from the NTTP to reduce the water inventory at the site and the volume of contact water discharged.

The CDA dam safety guidelines (CDA 2013; CDA 2014) outline principles and approaches for the evaluation and safety management of dams and associated structures. Design, construction and operation of the NTTP and polishing pond will be in accordance with the CDA guidelines and outlining principles to reduce the risk of loss of life and damage to property and the environment from a dam breach, such as:

- Dam Safety Management System: provides a framework for safety activities, decisions and supporting processes within the context of public policies and the TMNBL's business objectives to manage risks associated with the NTTP and polishing pond dams.
- Operation, Maintenance, and Surveillance Manual: will be developed for the NTTP and polishing pond in accordance with The Mining Association of Canada (2017) best practices for tailings and water management facilities and CDA. The objective of the OMS manual is to outline practices to be followed for the safe and environmentally responsible management of tailings and water management facilities. The manual documents operating procedures for the dam and flow control equipment under normal, unusual, and emergency conditions, maintenance procedures to ensure that the dam remains in a safe and operational condition, and surveillance procedures to provide early identification and to allow for timely mitigation of conditions that might affect dam safety.
- Emergency Preparedness and Response Plans: will be prepared and maintained for the dams, in collaboration with the relevant municipal or government agencies, in order to reduce the consequences of dam failure or other incidents. The plan will include procedures to guide TMNBL and staff through the process of responding to an emergency at a dam, including procedures for external response agencies with responsibilities for public safety within the floodplain.
- Dam Safety Reviews: a systematic review and evaluation of all aspects of the design, construction, operation, maintenance, processes and systems affecting a dam's safety, including the dam safety management system. Dam safety reviews will be conducted based on the suggested frequency outlined by CDA according to the dam classification. In addition, formal dam inspections will be conducted annually to evaluate the condition of the components of the dam system under evaluation (including dam, discharge facilities, foundation, abutments, and reservoir).

- Design of Public Safety around Dams: mitigating the risks of accidents or incidents encountered by a member of the public in design and operation as a result of a hazard created by the presence or operation of a dam.

Aside from specific considerations related to TMF dams, severe weather could also lead to flooding and land erosion causing damage and failure of Project infrastructure (e.g., structures, access roads). This could in turn lead to the release of total suspended solids (TSS) or other contaminants of concerns within the mine site in surface runoff and other related environmental effects. As discussed in Section 5.10.3.1, long-term environmental management and Project longevity are inherent considerations in the best practices of Project design, development, and management. To address the effects of flooding, design, construction and planning of operation will consider the potential normal and extreme conditions that might be encountered both now and in the future. General inspection and maintenance programs will be implemented by TMNBL and help to reduce the deterioration of the infrastructure and will help to maintain compliance with applicable design criteria.

5.10.3.3 Forest Fires

The effects of forest fire on the Project may include:

- Reduced visibility and inability to maneuver construction and operation equipment due to smoke;
- Delays in receipt of materials and supplies (e.g., construction materials) and in delivering products;
- Changes to the ability of workers to access the site (e.g., if fire blocks access to transportation routes);
- Damage to infrastructure; and
- Loss of electrical power resulting in reduced visibility at night.

In the event of a forest fire in close proximity to Project components, there is potential risk of damage to exposed Project infrastructure. If a forest fire were to break out in direct proximity to the Project, emergency measures will be in place to quickly control and extinguish the flames prior to any contact to flammable structures.

New Brunswick has a forest fire control program in place to identify and control fires, reducing the potential magnitude and extent of any forest fire, and their potential consequential effects on the Project during any phase. The proposed safety and security programs for the Project are capable of rapid detection and response to forest fire threats. A cleared buffer will be maintained around Project infrastructure, where feasible, to reduce the potential for a fire to affect the structures (which given the nature of the materials they contain are inherently fire resistant).

Safety and security programs will be in place in conjunction with facility, community, and provincial emergency response crews to provide for rapid detection and response to fire threats. This includes fires that could start within the Project site, as well as fires approaching from outside the Project site (i.e., forest fires).

5.10.3.4 Seismic Activity

Though the Project lies within one of five seismic zones in southeastern Canada, the level of historical seismic activity in northeast New Brunswick (where the Project is located) is low. Other areas of the province (i.e., 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 substantive way is low. Though past seismic activity in an area is not necessarily an indicator that a major seismic event will or will not occur in the future, the likelihood of a major event occurring in the vicinity of the Project, that could cause substantive Project damage or interrupt operations during any phase, is low.

The TMF dam and related Project infrastructure will be designed and constructed to meet the seismicity requirements of the Canadian Dam Association Dam Safety Guidelines (CDA 2013; CDA 2014), and other applicable standards and guidelines for earthquakes in this area. A slope stability analysis will be conducted during the design process of the dam, which will include consideration of the annual exceedance probability (AEP) of a seismic event, dam classification, peak ground acceleration, and pseudo-static stability of the dam. For a “very high” risk dam classification, the TMF dam will be designed and built to withstand the design earthquake of half way between 1/2,475 and 1/10,000 AEP or MCE. The dam classification for the NTTP and polishing pond dams will be verified during the detailed design for the Project.

As discussed in section 5.10.3.2, once constructed, visual inspections of the TMF dams will be conducted routinely by TMNBL, and formal inspections under the CDA (2013) guidelines will be conducted by a qualified geotechnical engineer annually. As discussed in Section 5.10.3.2, the CDA dam safety guidelines requires a dam safety review to be completed on a routine frequency, every 5 years for a “very high” dam classification. Both annual inspections and dam safety reviews will consider seismicity and make recommendations for ongoing maintenance of the North Tributary Tailings Pond and polishing pond dams.

5.10.4 Summary for Effects of the Environment on the Project

The effects of the environment on the Project are considered in all infrastructure decisions and the lifecycle assessment including the design, construction, and operation and maintenance of the Project. The Project will be designed, constructed, and operated to maintain safety, integrity, and reliability in consideration of existing and reasonably predicted environmental forces in New Brunswick.

Given the mitigation measures described above, especially the life cycle design approach, there are no environmental attributes that, at any time during the Project, are anticipated to result in:

- A substantial change to the Project construction schedule (e.g., a delay resulting in the construction period being extended by one season);
- A long-term interruption to the Project operation schedule (e.g., an interruption in servicing such that production targets cannot be met); and
- Damage to Project infrastructure resulting in increased safety risk.

TMNBL will use an adaptive management approach in its activities throughout the life of the Project to monitor observed effects of the environment and adapt (e.g., repair/replace) the Project infrastructure or operations and closure as needed. However, in light of the design and construction of the Project to meet strict design standards and the inspection and maintenance to be carried out to Project infrastructure, effects of the environment on the Project are not expected to be substantive.

6.0 SUMMARY OF PROPOSED MITIGATION

Proposed mitigation for the Project is summarized in Table 6.1 below.

Table 6.1 Summary of Proposed Mitigation

#	Valued Component (VC) (if applicable)	Project Phase	Proposed Mitigation/Compensation Measure	Location within EIA Registration Document where Mitigation Measure is Identified
1.	N/A	Operation	An emergency spillway will be constructed adjacent to the TMF dam in order to route water from extreme weather events around the main dam structure and the polishing pond.	Section 2.3.1.1 Stage 1 TMF Dam, Emergency Spillway and TMF Basin
2.	N/A	Construction	All dam designs will meet the most up to date Canadian Dam Association (CDA) Dam Safety Guidelines.	Section 2.3.1.1 Stage 1 TMF Dam, Emergency Spillway and TMF Basin
3.	N/A	Construction	Water quality modelling will be completed to determine water treatment facility requirements for the Project.	Section 2.3.1.3 Water Treatment Facility
4.	N/A	Construction	Water quality modelling for all waters which will be reporting into the new TMF basin will be initiated in the coming months to determine if water treatment will be required, and if additional water treatment capacity is required beyond that currently available at the Caribou mine site. In the event that additional water treatment capacity is required under the new flow regime, additional treatment options will be examined as part of the broader project scope.	Section 2.3.1.3 Water Treatment Facility
5.	N/A	Construction	Temporary internal site roads within the PDA area will be designed to provide safe and efficient movement of equipment and personnel throughout the site and have restricted access for all non-mine equipment and vehicles during construction.	Section 2.3.1.4 Access Road
6.	N/A	Construction	All efforts will be made to utilize existing forest resource roads and water crossings for accessing the mine site, in order to limit environmental disturbance. Any new access roads and/or rehabilitated roads will be designed and constructed in consideration of standards for forest resource roads in New Brunswick (NBDNR 2004).	Section 2.3.2.2 Alternative Access Road
7.	N/A	Construction	Grubbings and topsoil removed as part of construction will be stockpiled within the PDA or cleared and disturbed areas of the existing mine site for use during closure activities.	Section 2.4.1.1 TMF Dam (Stage 1) and Polishing Pond
8.	N/A	Construction	Timber removed from the PDA will be sold to local markets and stumpage fees paid to the province.	Section 2.4.1.1 TMF Dam (Stage 1) and Polishing Pond
9.	N/A	Construction	As part of site preparation, defined construction zones will be established, and signage or barriers will be installed to control access.	Section 2.4.1.1 TMF Dam (Stage 1) and Polishing Pond
10.	N/A	Construction	To complete the work, it will be necessary to isolate the work site from the watercourse so that work can be completed under dry conditions. A cofferdam will be installed below the confluence of the north and south tributaries to Forty Mile Brook above the NTTP dam location. Any seapage below the cofferdam will be pumped back upstream to maintain dry condition.	Section 2.4.1.1 TMF Dam (Stage 1) and Polishing Pond
11.	N/A	Construction	Prior to installing the cofferdam, the Fire Pond and STTP water levels will be lowered to their lowest operating level so that each basin can be used to maximize water storage during the construction period. These areas will serve as "surge" basins for any flood conditions arising during construction. A combination of diversion options such as pumping and/or diversion channels will be examined as part of the detailed engineering stage of the Project.	Section 2.4.1.1 TMF Dam (Stage 1) and Polishing Pond
12.	N/A	Construction	At Stage 2, if the mill is closed and decommissioned, the reclaim pump station or inlet structure will be decommissioned. Where possible, pumping and electrical equipment will be sold and or recycled in an approved facility.	Section 2.4.1.3 Permanent and Temporary Ancillary Facilities - Reclaim Pumphouse
13.	N/A	Construction	During construction of access roads, all efforts will be made to use existing forestry roads and water crossings.	Section 2.4.1.3 Permanent and Temporary Ancillary Facilties - Access Road
14.	N/A	Construction	Right-of-ways will be cleared as required in accordance with guidelines, standards and best practices for developing forest resource roads (NBDNR 2004).	Section 2.4.1.3 Permanent and Temporary Ancillary Facilties - Access Road
15.	N/A	Construction	Erosion control and dust suppression measures will be implemented to reduce the potential environmental effects of activities on nearby watercourses.	Section 2.4.1.3 Permanent and Temporary Ancillary Facilties - Access Road
16.	N/A	Construction	A watercourse and wetland alteration permit will be obtained prior to construction for all activities within 30 m of a watercourse or wetland, and the proponent will adhere to permit conditions.	Section 2.4.1.3 Permanent and Temporary Ancillary Facilties - Access Road

Table 6.1 Summary of Proposed Mitigation

#	Valued Component (VC) (if applicable)	Project Phase	Proposed Mitigation/Compensation Measure	Location within EIA Registration Document where Mitigation Measure is Identified
17.	N/A	Construction	Best management practices for the use of forest roads in New Brunswick will be implemented and a Traffic Plan developed in consultation with the Crown Timber Licence Holders and NBDERD.	Section 2.4.1.3 Permanent and Temporary Ancillary Facilties - Access Road
18.	N/A	Construction	Best management practices will be applied during the operation of the borrow source by providing dust suppression (if required) of the stockpiled material and access roads. Erosion and sediment control such as settling ponds to manage waters that may contain TSS will also be implemented as required.	Section 2.4.1.3 Permanent and Temporary Ancillary Facilties – Borrow Sources
19.	N/A	Operation	Water levels in the NTTP will be managed within the existing operational limits to maintain a minimum of 1 m water cover over the tailings. Excess water during periods of high flow will be managed by discharging treated water in a controlled manner to the Polishing Pond . During extreme weather events, excess water will be routed around the dam and polishing pond via the emergency spillway. Water levels in the TMF headpond will be managed similar to current conditions. Freeboard requirements will be confirmed during detailed design and meet the current CDA Guidelines.	Section 2.4.2.1 NTTP Dam and Polishing Pond
20.	N/A	Operation	The Operational, Management, and Surveillance (OMS) Manual of the TMF and associated dams will be completed as per the CDA and Mining Association of Canada (MAC) guidelines. As is current dam safety management practice for the existing dam infrastructure at the Caribou mine site, weekly dam inspections will be completed on the TMF dam. Safety procedures such as implementing yearly dam inspection done by qualified engineering personnel as well as dam safety reviews held every 5 to 10 years will continue to be completed as per CDA guidelines for the TMF dam (Stage 1 and Stage 2).	Section 2.4.2.1 NTTP Dam and Polishing Pond
21.	N/A	Operation	Mine effluent will continue to be treated to meet or exceed provincial (Approval to Operate) and federal guidelines (MDMER). Exact details of on-going water treatment operating requirements at the site are not yet known and will be determined based on the results of planned water quality modelling for the Project.	Section 2.4.2.2 Water Treatment Facility
22.	N/A	Closure/Post-Closure	At closure, the water treatment facility will remain in operation for a minimum of three years, with provisions for long-term mine water treatment as determined during the initial three years. Water treatment activities will only cease if/when provincial and federal water quality guidelines are consistently met without treatment at the final discharge point. In the interim, the water treatment facility will continue to be maintained and serviced as is currently the case	Section 2.4.3.2 Water Treatment Facility
23.	N/A	Closure/Post-Closure	Surface infrastructure will either be removed from the property or disposed of off-site, depending upon the nature of the material. All efforts will be made to sell and/or recycle materials in an approved facility. Grading and/or scarification of disturbed areas will be performed to promote natural vegetation, or placement and grading of overburden for vegetation in areas will occur where natural vegetation is not sufficiently rapid to control erosion and sedimentation.	Section 2.4.3.3 Permanent and Temporary Ancillary Facilities
24.	N/A	Construction, Operation, Closure/Post-Closure	TMNBL will plan to meet or exceed the compliance standards outlined in applicable regulations and guidelines with respect to waste, emissions, and discharges from the Project. Where no standards exist, industry best practices will be adopted, where applicable. Volumes of wastes and concentrations of contaminants entering the environment will be reduced through best management practices, following applicable legislation, and mitigation planning as outlined in TMNBL's Site Specific Environmental Management Plan (TSSEMP; TMNBL 2015).	Section 2.6 Emissions and Waste
25.	N/A	Construction, Operation, Closure/Post-Closure	Control measures, such as use of dust suppression techniques, will be used as required to reduce the fugitive dust, and routine inspection and maintenance of construction equipment will reduce exhaust fumes. The burning of waste brush/slash material will not be permitted.	Section 2.6.1 Air Contaminant Emissions
26.	N/A	Construction, Operation, Closure/Post-Closure	Noise sources will be mitigated through the use of mufflers.	Section 2.6.3 Noise and Vibration Emissions
27.	N/A	Construction, Operation, Closure/Post-Closure	Liquid wastes that are considered dangerous goods (e.g. oils and lubricants) will be collected and disposed of in accordance with applicable local and provincial regulations. Other liquid wastes, including sewage and domestic wastewater, will also be collected and disposed of off-site consistent with local and provincial standards.	Section 2.6.4 Liquid Wastes
28.	N/A	Construction, Operation, Closure/Post-Closure	Mine contact water from the Caribou mine site will be collected and directed to the new TMF for storage, reclaim, and/or treatment and discharge, as applicable. Surplus water from the TMF will be treated in the water treatment facility to meet provincial and federal water quality requirements. Any waste oils and lubricants will be taken to an approved disposal facility by a licensed contractor.	Section 2.6.4 Liquid Wastes

Table 6.1 Summary of Proposed Mitigation

#	Valued Component (VC) (if applicable)	Project Phase	Proposed Mitigation/Compensation Measure	Location within EIA Registration Document where Mitigation Measure is Identified
29.	N/A	Construction, Operation, Closure/Post-Closure	TMNBL will actively cooperate with municipal waste reduction and recycling programs and will encourage conservation throughout construction and operation. Solid wastes will be collected and disposed of in a manner consistent with local and provincial standards. Non-hazardous wastes will be separated as recyclable and non-recyclable, with recyclable material collected and transported to a licensed recycling facility. An effort will be made to reduce the amount of waste generated by the application of 4-R principles (reduce, reuse, recycle, recover) to the extent practical. Non-recyclable wastes will be transported off-site to a permitted landfill.	Section 2.6.6 Solid and Hazardous Wastes
30.	N/A	Construction, Operation, Closure/Post-Closure	Dangerous goods will be stored onsite in a separate temporary dangerous goods storage area provided with full containment. Dangerous goods will be removed from the site by a licensed contractor or disposed at an approved facility.	Section 2.6.6 Solid and Hazardous Wastes
31.	N/A	Construction, Operation, Closure/Post-Closure	The CDA Guidelines specify that qualified third-party engineering firms conduct site investigations, develop designs, monitor construction, and inspect ongoing operations to ensure that the appropriate standards are met. For the Project, these include the following: • Design for geotechnical stability for the most significant earthquake loading relating to the largest applicable seismic event (known as the Maximum Design Earthquake); • Design for safe containment of all rainfall and run-off resulting from the Inflow Design Flood (IDF) at all times during operation and for attenuation and safe passage of the IDF after closure; • A Failure Mode Analysis by qualified independent specialists to ensure that the TMF embankment design and operating plan adequately address any and all potential failure causes and mechanisms; • Quality assurance and inspections by the design engineers during initial and ongoing construction of the TMF; • Monitoring and inspections during operation (including a five-year review under the CDA Guidelines conducted by a qualified geotechnical engineer) to assess TMF performance and to identify any conditions that differ from those assumed during the design; and • Scheduled ongoing inspections and audits of the facility by qualified geotechnical engineers during operation and after closure.	Section 2.7.1 Loss of Containment from the TMF
32.	N/A	Construction, Operation, Closure/Post-Closure	All effluent released from the Project will be monitored to verify that it meets MDMER or other effluent quality requirements as defined by the Approval to Operate for the Project. In the event that contaminant limits above the permitted levels are indicated, if there is sufficient retention volume available in the NTTP the water treatment plant will be temporarily shut down until repairs to the facility can be implemented and/or changes to the treatment process can be implemented in order to meet the permitted levels for effluent release.	Section 2.7.3 Release of Off-Specification Effluent from the Water Treatment Facility
33.	N/A	Construction, Operation, Closure/Post-Closure	TMNBL and their contractor(s) will take necessary precautions to avoid hazardous material spills, including the designation of fuel storage and fueling areas according to provincial policy such that construction activities will not result in the release of harmful material or substances and take necessary measures for containing and cleaning up spills which may occur, in a safe and efficient manner, and in accordance with federal and provincial reporting requirements.	Section 2.7.4 Hazardous Materials Spill
34.	N/A	Construction, Operation, Closure/Post-Closure	Standard erosion and sediment control measures, including the use of sediment/silt fencing and check dams, will be utilized where deemed necessary. Inspection and monitoring of erosion and sediment control measures will be conducted regularly during the construction stage of the Project, particularly during and after extreme precipitation events that result in visible overland flow of water. Erosion and sediment control structures found to be damaged will be repaired immediately and any other remedial action will be taken as necessary.	Section 2.7.5 Erosion and Sediment Control Failure
35.	N/A	Construction, Operation, Closure/Post-Closure	Proper materials management (i.e., of fuel and other hazardous materials) and operational procedures (i.e., storage, handling and transfer) will reduce the potential for, and extent of, accidental Project-related fires. Work permits, under the Forest Fire Act, will be obtained prior to construction or as needed for other industrial activities within forested lands. In the unlikely event of a large fire, local emergency response and firefighting capability will be called to respond to reduce the severity and extent of damage and to protect the safety of workers. Fire fighting equipment will be maintained at the work site.	Section 2.7.6 Fire
36.	N/A	Construction, Operation, Closure/Post-Closure	A Heritage Resources Discovery Plan will be developed for the Project. In general, this Plan will state that in the event Project personnel encounter any potential archaeological resources, work in the immediate area of the find will be halted and a buffer (e.g., 10 m radius) will be established around the discovery until it can be properly investigated. If the find is determined to be archaeological in nature, an appropriate mitigation strategy will be developed in consultation with the Archaeological Services Branch of the New Brunswick Department of Tourism, Heritage and Culture, and if the site is related to Indigenous use of the land, that consultation will include the local Indigenous Community and Archaeological Services. Archaeological resources can only be investigated and mitigated by a professional archaeologist permitted by the Province of New Brunswick.	Section 2.7.7 Discovery of a Heritage Resource
37.	N/A	Construction, Operation, Closure/Post-Closure	In the event that Project personnel encounter any suspected palaeontological resources such as fossils within the PDA, the Heritage Resources Discovery Plan will note that the Heritage Conservation Act requires that such finds be reported to the New Brunswick Museum. Depending on the nature of the discovery, a permit may be required to collect and remove any identified fossils.	Section 2.7.7 Discovery of a Heritage Resource

Table 6.1 Summary of Proposed Mitigation

#	Valued Component (VC) (if applicable)	Project Phase	Proposed Mitigation/Compensation Measure	Location within EIA Registration Document where Mitigation Measure is Identified
38.	N/A	Construction, Operation, Closure/Post-Closure	Project-related vehicles will observe all traffic rules and provincial and federal highway regulations. Trucking activity for construction will take place on designated routes, and traffic control will be implemented if needed, but is not anticipated.	Section 2.7.8 Vehicle Accident
39.	N/A	Construction, Operation, Closure/Post-Closure	In case of persistent or dangerous wildlife encounters, TMNBL personnel shall notify NBDERD of the situation.	Section 2.7.9 Wildlife Encounters
40.	Assessment of Potential Environmental Interactions with the Atmospheric Environment	Construction, Operation, Closure/Post-Closure	TMNBL will control CAC emissions from Project activities by implementing the following mitigation measures: • Manage vehicle and equipment emissions by conducting regular maintenance on all machinery and equipment; • Control construction-related fugitive road dust, through measures such as speed limits on Project-controlled gravel roads and road watering on an as-needed basis; • Prohibit the burning of waste materials; and • Reduce haul distances to disposal sites	Section 5.3.3.1 Air Quality
41.	Assessment of Potential Environmental Interactions with the Atmospheric Environment	Construction	Emissions of GHGs during construction will be reduced to the extent practical by: • Minimize the footprint of the TMF to limit the extent of disturbance • Using construction equipment that is well maintained; • Implementing an idling awareness program to reduce unnecessary diesel or gasoline fueled equipment idling; and • Reducing haul distances to disposal sites.	Section 5.3.3.2 Greenhouse Gas Emissions
42.	Assessment of Potential Environmental Interactions with the Atmospheric Environment	Construction, Closure/Post- Closure	The following mitigation for sound will be considered and implemented, as needed: • Use of well-maintained construction equipment with appropriate mufflers; • Use of acoustical barriers (e.g., engineered materials or stockpiled overburden) near loud sources during construction if feasible; • Sizing of construction equipment to the smallest needed to perform the work; and • Work will mostly be conducted during daytime hours.	Section 5.3.3.3 Sound Quality
43.	Assessment of Potential Environmental Interactions with Groundwater	Construction	Potential Project interactions with groundwater will be managed through use of standard mitigation measures. This includes the development of an ARD management plan to manage activities that expose bedrock with a high ARD potential during construction activities.	Section 5.4.3.4 Mitigation for Groundwater
44.	Assessment of Potential Environmental Interactions with Groundwater	Operation, Closure/Post-Closure	The operation of perimeter engineered drainage collection channels at the toe of the TMF dam will collect a portion of the groundwater seepage and direct it to the polishing pond where it will either be blended with treated effluent, pumped back to the TMF for storage, or pumped back to the water treatment facility for treatment. Should groundwater seepage that bypasses the drainage collection system result in poor quality in Forty Mile Brook, groundwater pump-back wells could be installed to manage groundwater seepage by pumping it to the water treatment facility for treatment.	Section 5.4.3.4 Mitigation for Groundwater
45.	Assessment of Potential Environmental Interactions with Surface Water	Construction	Parameters such as total suspended solids will be measured upstream and downstream of the PDA periodically throughout construction, in accordance with the TSSEMP and any permitting requirements for the Project (such as the Wetland and Watercourse Alteration Permit).	Section 5.5.3.1 Construction Phase - Sediment Transport to Forty Mile Brook
46.	Assessment of Potential Environmental Interactions with Surface Water	Construction	The cofferdam will be constructed with clean non-sulphide bearing rock fill or till to decrease the amount of sediment introduced to the river and the introduction of acid-bearing sulphides.	Section 5.5.3.1 Construction Phase - Change to Water Quality due to Sediments
47.	Assessment of Potential Environmental Interactions with Surface Water	Construction	Turbidity curtains will be installed around the perimeter of the downstream work area to control suspended sediments to the work area. Sedimentation and erosion will be further reduced by conducting in-stream work during periods of lower flow and over the shortest duration possible based on conditions present at the time of construction.	Section 5.5.3.1 Construction Phase - Change to Water Quality due to Sediments
48.	Assessment of Potential Environmental Interactions with Surface Water	Construction	Drawdown of the Fire Pond will be carefully controlled through the removal of stop logs at the Fire Pond spillway to gradually release water from these facilities to avoid sudden changes in flow downstream of the main branch of Forty Mile Brook.	Section 5.5.3.1 Construction Phase - Change to Operating Water Level
49.	Assessment of Potential Environmental Interactions with Surface Water	Operation	Tailings will be deposited sub-aqueously within the TMF similar to current conditions to minimize the potential for metal leaching and acidic drainage	Section 5.5.3.2 Operation Phase - Change to Water Quality

Table 6.1 Summary of Proposed Mitigation

#	Valued Component (VC) (if applicable)	Project Phase	Proposed Mitigation/Compensation Measure	Location within EIA Registration Document where Mitigation Measure is Identified
50.	Assessment of Potential Environmental Interactions with Surface Water	Closure/Post-Closure	Physical construction of the alternative access road and internal site roads within the PDA may interrupt overland flow drainage patterns and watercourse crossings, and will be mitigated with properly-sized culverts and standard sediment control mitigation measures. Roadside ditches will route overland flow to local watercourses with appropriate sediment control measures in place.	Section 5.5.3.3 Closure/Post-Closure Phase
51.	Assessment of Potential Environmental Interactions with Fish and Fish Habitat	Construction, Operation, Closure/Post-Closure	TMNBL will obtain a WAWA permit, administered through NBDELG, for any in-water works or work within 30 m of a watercourse, and will comply with its conditions. DFO will be consulted to develop offsetting as appropriate, with consideration of the “Fisheries Productivity Investment Policy: A Proponent’s Guide to Offsetting” (DFO 2013b).	Section 5.6.3.4 Mitigation for Fish and Fish Habitat
52.	Assessment of Potential Environmental Interactions with Fish and Fish Habitat	Construction, Closure/Post-Closure	Any in-water and/or work below the high-water mark will be conducted between June 1 and September 30, unless otherwise permitted through consultation with NBDELG and/or DFO. Every reasonable effort will be made to reduce the duration of instream works.	Section 5.6.3.4 Mitigation for Fish and Fish Habitat
53.	Assessment of Potential Environmental Interactions with Fish and Fish Habitat	Construction, Operation, Closure/Post-Closure	Effective erosion and sediment control measures will be installed prior to starting work to prevent sediment or contaminants from entering any watercourses, and inspected regularly. Turbidity curtains or silt fences will be installed at the cofferdam location. Any waste material will be stabilized or contained. Control structures will be inspected and maintained over the course of the construction until the disturbed area has stabilized, and natural revegetation has occurred. Non-biodegradable materials will be removed.	Section 5.6.3.4 Mitigation for Fish and Fish Habitat
54.	Assessment of Potential Environmental Interactions with Fish and Fish Habitat	Construction, Closure/Post-Closure	In-water worksites will be isolated from flowing water (i.e., by using a cofferdam) to contain or reduce suspended sediment where possible. Clean, low permeability material and rockfill will be used to construct the cofferdam, TMF and Polishing Pond. When possible, operate machinery above the high-water mark or inside of isolated areas	Section 5.6.3.4 Mitigation for Fish and Fish Habitat
55.	Assessment of Potential Environmental Interactions with Fish and Fish Habitat	Construction, Closure/Post-Closure	Prior to construction, best efforts will be made by a qualified environmental professional to relocate fish from within areas of in-water works or areas of water drawdown to an appropriate location in the same waters.	Section 5.6.3.4 Mitigation for Fish and Fish Habitat
56.	Assessment of Potential Environmental Interactions with Fish and Fish Habitat	Construction, Operation, Closure/Post-Closure	Refueling, servicing, and equipment storage will take place beyond 30 m of the watercourse to reduce the likelihood that deleterious substances will enter watercourses. Emergency spill response kits will be kept on-site during construction	Section 5.6.3.4 Mitigation for Fish and Fish Habitat
57.	Assessment of Potential Environmental Interactions with Fish and Fish Habitat	Construction, Closure/Post-Closure	Temporary storage of waste materials on-site will be located at least 30 m from watercourse in a prepared location.	Section 5.6.3.4 Mitigation for Fish and Fish Habitat
58.	Assessment of Potential Environmental Interactions with Fish and Fish Habitat	Construction, Operation, Closure/Post-Closure	Minimum flows will be maintained as described in the Approval to Operate and in consideration of the Conceptual Water Management Plan	Section 5.6.3.4 Mitigation for Fish and Fish Habitat
59.	Assessment of Potential Environmental Interactions with Fish and Fish Habitat	Construction, Closure/Post-Closure	Fish screens and/or other barriers will be installed/maintained to prevent fish from migrating into the NTTP.	Section 5.6.3.4 Mitigation for Fish and Fish Habitat
60.	Assessment of Potential Environmental Interactions with Fish and Fish Habitat	Construction, Closure/Post-Closure	Trees and debris will be cleared and removed within the flooded area of the Stage 1 and Stage 2 TMF	Section 5.6.3.4 Mitigation for Fish and Fish Habitat
61.	Assessment of Potential Environmental Interactions with Vegetation and Wetlands	Construction, Closure/Post-Closure	Conduct confirmatory field work in the Stage 1 PDA (summer 2018) and Stage 2 PDA (later, prior to any construction for Stage 2) to assess the presence or absence of plant SAR and SOCC.	Section 5.7.3.4 Mitigation for Vegetation and Wetlands
62.	Assessment of Potential Environmental Interactions with Vegetation and Wetlands	Construction, Closure/Post-Closure	Conduct confirmatory field work in the Stage 1 PDA (summer 2018) and Stage 2 PDA (later, prior to any construction for Stage 2) to delineate and evaluate the function of wetlands in the PDAs.	Section 5.7.3.4 Mitigation for Vegetation and Wetlands
63.	Assessment of Potential Environmental Interactions with Vegetation and Wetlands	Construction, Closure/Post-Closure	Avoid, to the extent feasible, known locations of wildlife SAR and SOCC.	Section 5.7.3.4 Mitigation for Vegetation and Wetlands
64.	Assessment of Potential Environmental Interactions with Vegetation and Wetlands	Construction, Closure/Post-Closure	Restrict clearing activities to the minimum amount required, particularly around wetlands.	Section 5.7.3.4 Mitigation for Vegetation and Wetlands

Table 6.1 Summary of Proposed Mitigation

#	Valued Component (VC) (if applicable)	Project Phase	Proposed Mitigation/Compensation Measure	Location within EIA Registration Document where Mitigation Measure is Identified
65.	Assessment of Potential Environmental Interactions with Vegetation and Wetlands	Construction, Operation, Closure/Post-Closure	Employ standard erosion and sedimentation control measures, particularly to avoid silt laden runoff into wetlands. Implement standard dust control measures to avoid siltation of wetlands.	Section 5.7.3.4 Mitigation for Vegetation and Wetlands
66.	Assessment of Potential Environmental Interactions with Vegetation and Wetlands	Construction, Closure/Post-Closure	Use quarried, crushed material for road building and construction of the dams in and near wetlands, to reduce the risk of introducing or spreading exotic and/or invasive vascular plant species.	Section 5.7.3.4 Mitigation for Vegetation and Wetlands
67.	Assessment of Potential Environmental Interactions with Vegetation and Wetlands	Construction, Closure/Post-Closure	Equipment arriving on site should be cleaned before arriving on site to minimize the spread of invasive plant species.	Section 5.7.3.4 Mitigation for Vegetation and Wetlands
68.	Assessment of Potential Environmental Interactions with Vegetation and Wetlands	Construction, Closure/Post-Closure	Operate vehicles and equipment on previously disturbed areas, wherever feasible.	Section 5.7.3.4 Mitigation for Vegetation and Wetlands
69.	Assessment of Potential Environmental Interactions with Vegetation and Wetlands	Construction, Closure/Post-Closure	Limit size of temporary workspaces; use previously disturbed areas or areas to be flooded rather than natural areas outside the TMF PDA.	Section 5.7.3.4 Mitigation for Vegetation and Wetlands
70.	Assessment of Potential Environmental Interactions with Vegetation and Wetlands	Construction, Closure/Post-Closure	Allow for natural regeneration of vegetation when practicable, and when not practicable, use a native seed mix for revegetation, progressively during operation and at closure.	Section 5.7.3.4 Mitigation for Vegetation and Wetlands
71.	Assessment of Potential Environmental Interactions with Vegetation and Wetlands	Construction, Closure/Post-Closure	Restore temporarily disturbed areas to near pre-construction conditions. Rehabilitate access routes that are no longer needed.	Section 5.7.3.4 Mitigation for Vegetation and Wetlands
72.	Assessment of Potential Environmental Interactions with Vegetation and Wetlands	Construction, Closure/Post-Closure	Compensate for net loss of wetland function of GeoNB-mapped wetlands arising as a result of the Project	Section 5.7.3.4 Mitigation for Vegetation and Wetlands
73.	Assessment of Potential Environmental Interactions with Vegetation and Wetlands	Construction, Closure/Post-Closure	Should any plant SAR or SOCC be found within the PDA during upcoming field surveys, NBDELG will be notified and mitigation to reduce the effect of the Project on these species will be developed in consultation with NBDELG.	Section 5.7.3.4 Mitigation for Vegetation and Wetlands
74.	Assessment of Potential Environmental Interactions with Wildlife and Wildlife Habitat	Construction, Closure/Post-Closure	Conduct confirmatory field work in the Stage 1 PDA (spring-summer 2018) and Stage 2 PDA (later, prior to any construction for Stage 2) to confirm the presence or absence of bird SAR and SOCC.	Section 5.8.3.4 Mitigation for Wildlife and Wildlife Habitat
75.	Assessment of Potential Environmental Interactions with Wildlife and Wildlife Habitat	Construction, Closure/Post-Closure	Conduct a basking survey for turtles in the affected reaches of Forty Mile Brook in spring-summer 2018, in conjunction with other field surveys, to determine the potential presence of wood turtle or common snapping turtle.	Section 5.8.3.4 Mitigation for Wildlife and Wildlife Habitat
76.	Assessment of Potential Environmental Interactions with Wildlife and Wildlife Habitat	Construction, Closure/Post-Closure	Record incidental observations of wildlife during targeted field surveys.	Section 5.8.3.4 Mitigation for Wildlife and Wildlife Habitat
77.	Assessment of Potential Environmental Interactions with Wildlife and Wildlife Habitat	Construction, Closure/Post-Closure	Locating linear facilities within existing right-of-ways adjacent to other linear facilities, where possible, to minimize fragmentation and creation of edge.	Section 5.8.3.4 Mitigation for Wildlife and Wildlife Habitat
78.	Assessment of Potential Environmental Interactions with Wildlife and Wildlife Habitat	Construction, Closure/Post-Closure	Establishment of buffers and protection of active migratory bird nests until fledging, upon their discovery in work areas during construction.	Section 5.8.3.4 Mitigation for Wildlife and Wildlife Habitat
79.	Assessment of Potential Environmental Interactions with Wildlife and Wildlife Habitat	Construction, Operation, Closure/Post-Closure	Use approved noise arrest mufflers on equipment to reduce potential environmental effects of noise.	Section 5.8.3.4 Mitigation for Wildlife and Wildlife Habitat

Table 6.1 Summary of Proposed Mitigation

#	Valued Component (VC) (if applicable)	Project Phase	Proposed Mitigation/Compensation Measure	Location within EIA Registration Document where Mitigation Measure is Identified
80.	Assessment of Potential Environmental Interactions with Wildlife and Wildlife Habitat	Construction, Operation, Closure/Post-Closure	Use full cut-off lighting during construction to reduce attraction to migrating birds.	Section 5.8.3.4 Mitigation for Wildlife and Wildlife Habitat
81.	Assessment of Potential Environmental Interactions with Wildlife and Wildlife Habitat	Construction, Operation, Closure/Post-Closure	Properly store and dispose of construction site wastes that might attract wildlife.	Section 5.8.3.4 Mitigation for Wildlife and Wildlife Habitat
82.	Assessment of Potential Interactions with Heritage Resources	Construction, Closure/Post-Closure	Completion of an archaeological impact assessment (AIA) including a walkover survey of the Stage 1 PDA for the Project to identify areas of elevated potential for archaeological resources within the PDA.	Section 5.9.3.1 Construction Phase
83.	Assessment of Potential Interactions with Heritage Resources	Construction, Closure/Post-Closure	Implement appropriate mitigation such as shovel testing in areas identified as having elevated potential for archaeological resources (as determined by the walkover survey conducted as part of the AIA) that will be directly affected by construction activities or indirectly affected by flooding of the TMF.	Section 5.9.3.1 Construction Phase
84.	Assessment of Potential Interactions with Heritage Resources	Construction, Closure/Post-Closure	Should any heritage resources be identified that could be affected by the Project, additional mitigation, as required, will be developed in consultation with provincial regulators (e.g. Archaeological Services Branch or the New Brunswick Museum) and First Nations, as applicable.	Section 5.9.3.1 Construction Phase
85.	Assessment of Potential Interactions with Heritage Resources	Construction, Closure/Post-Closure	Implement archaeological monitoring during construction activities in areas of elevated archaeological potential where shovel testing is not practicable.	Section 5.9.3.1 Construction Phase
86.	Assessment of Potential Interactions with Heritage Resources	Construction, Closure/Post-Closure	A heritage resource discovery contingency plan will be included in the environmental management plan in the event that heritage resources, such as archaeological or fossil sites, are encountered during construction activities.	Section 5.9.3.1 Construction Phase
87.	Assessment of Potential Effects of the Environment on the Project	Construction, Operation, Closure/Post-Closure	The effects of severe weather (including as these may change with a change in climate) will be mitigated through: • Careful and considered design in accordance with factors of safety, best engineering practice, and adherence with standards and codes (e.g., Canadian Dam Association Guidelines (CDA 2013); Canadian Dam Association Technical Bulletin on the Application of Dam Safety Guidelines to Mining Dams (CDA 2014); Canadian Standards Association standards) • Engineering design practices that will consider predictions for climate and climate change (e.g., the Public Infrastructure Engineering Vulnerability Committee (PIEVC) “Engineering Protocol for Infrastructure Vulnerability Assessment and Adaptation to a Changing Climate” (PIEVC 2014)) • Inspection and maintenance programs that will reduce the deterioration of the infrastructure and will help to maintain compliance with applicable design criteria and reliability of the Project.	Section 5.10.3.1 Climate and Climate Change
88.	Assessment of Potential Effects of the Environment on the Project	Construction, Closure/Post-Closure	Further to responsible design and construction of the Project, and ongoing inspection and maintenance, the selection of materials that are able to withstand temperatures and loads will more than adequately address climate concerns. The selection of materials that withstand potential environmental stressors related to climate will include engineering specifications of the Canadian Standards Association and other construction standards that contain design specific provisions, such as: • Critical structures that will be constructed with resilient materials to prevent brittle fracture at low ambient temperature conditions • Critical structures that will be constructed to withstand the structural loading expected with high winds and weight associated with ice and snow.	Section 5.10.3.1Climate and Climate Change
89.	Assessment of Potential Effects of the Environment on the Project	Construction, Operation, Closure/Post-Closure	The NTTP and polishing pond will be designed, constructed, and operated in accordance to the Canadian Dam Association’s dam safety guidelines (CDA 2013; CDA 2014) to reduce risk of failure and subsequent flooding. The selection of appropriate design earthquake and flood events for dams in Canada is based on the dam classification and recommended design values set out by the CDA.	Section 5.10.3.2 Flooding
90.	Assessment of Potential Effects of the Environment on the Project	Construction, Operation, Closure/Post-Closure	Design, construction and operation of the NTTP and polishing pond will be in accordance with the CDA guidelines and outlining principles to reduce the risk of loss of life and damage to property and the environment from a dam breach, such as: • Dam Safety Management System • Operation, Maintenance, and Surveillance Manual • Emergency Preparedness and Response Plans • Dam Safety Reviews • Design of Public Safety around Dams	Section 5.10.3.2 Flooding

Table 6.1 Summary of Proposed Mitigation

#	Valued Component (VC) (if applicable)	Project Phase	Proposed Mitigation/Compensation Measure	Location within EIA Registration Document where Mitigation Measure is Identified
91.	Assessment of Potential Effects of the Environment on the Project	Construction, Operation, Closure/Post-Closure	A cleared buffer will be maintained around Project infrastructure, where feasible, to reduce the potential for a fire to affect the structures (which given the nature of the materials they contain are inherently fire resistant).	Section 5.10.3.3 Forest Fires
92.	Assessment of Potential Effects of the Environment on the Project	Construction, Operation, Closure/Post-Closure	Safety and security programs will be in place in conjunction with facility, community, and provincial emergency response crews to provide for rapid detection and response to fire threats.	Section 5.10.3.3 Forest Fires
93.	Assessment of Potential Effects of the Environment on the Project	Construction, Closure/Post-Closure	The TMF dam and related Project infrastructure will be designed and constructed to meet the seismicity requirements of the Canadian Dam Association Dam Safety Guidelines (CDA 2013; CDA 2014), and other applicable standards and guidelines for earthquakes in this area. A slope stability analysis will be conducted during the design process of the dam, which will include consideration of the annual exceedance probability (AEP) of a seismic event, dam classification, peak ground acceleration, and pseudo-static stability of the dam.	Section 5.10.3.4 Seismic Activity
94.	Assessment of Potential Effects of the Environment on the Project	Construction, Closure/Post-Closure	Visual inspections of the TMF dams will be conducted routinely by TMNBL, and formal inspections under the CDA (2013) guidelines will be conducted by a qualified geotechnical engineer annually. The CDA dam safety guidelines requires a dam safety review to be completed on a routine frequency, every 5 years for a “very high” dam classification. Both annual inspections and dam safety reviews will consider seismicity and make recommendations for ongoing maintenance of the NTTP and polishing pond dams.	Section 5.10.3.4 Seismic Activity

7.0 INDIGENOUS ENGAGEMENT

TMNBL has initiated an Indigenous engagement program to inform First Nations communities and groups about the Project. The Indigenous engagement program will use a multi-faceted approach to ensure that Project information reaches as many First Nations persons as possible. This program will make use of existing relationships with First Nations in the area through early communication through the TMNBL Indigenous representative serving in the role of TMNBL's Mi'gmaq Benefits Manager for Indigenous participation in the existing mine operations. Indigenous engagement will be completed in accordance with the Indigenous Benefits Agreement (IBA) in place with the nine Mi'gmaq First Nations.

7.1 OBJECTIVES

The objectives of the Indigenous engagement program are as follows:

- Provide information directly to First Nations communities in the vicinity of the Project and associated First Nations groups;
- Address issues and concerns raised during this process; and
- Identify measures that will mitigate or resolve First Nations' issues or concerns proposed during future engagement initiatives.

7.2 COMMUNICATION METHODS

The methods employed to communicate with the nine Mi'gmaq First Nations communities are described below:

- **Direct Engagement –** First Nations communities will be engaged through early communication via the TMNBL Benefits Manager. First Nations input will be sought on the overall engagement process for their communities and other Indiginous persons that they may identify as being potentially affected by the Project. TMNBL has met with the Chief and Council of the nine Mi'gmaq First Nations to discuss activities at the mine site. To date, no specific issues have been brought forward regarding current use activities that may be affected by Project related activities. TMNBL is planning further meetings with the Mi'gmaq Chiefs that wish to be further engaged regarding the Project and will be asking if additional information is needed, or if there is a desire for additional consultation in the communities about this proposed Project. A list of First Nations communities and groups that will be engaged as part of the Project is presented in Table 7.1 below.
- **Information Package –** Bilingual information packages will be provided to interested First Nations communities or organizations that wish to receive information about the Project. The package will include a cover letter addressed to the various First Nations communities and groups with fact sheets on the proposed undertaking.
- **Open House –** If requested, one open house will be completed at the Pabineau First Nation community hall to provide an opportunity for members of the community to learn about the Project.
- **Viewing of the EIA Registration –** An electronic copy of the EIA Registration document will be made available on the NBDELG website (http://www2.gnb.ca/content/gnb/en/departments/elg.html), and a paper copy will be made available for viewing during the public review period at the following locations:
  - NBDELG Bathurst Regional Office
  - NBDELG Project and Approvals Branch (Fredericton)

- **Web Postings** – The TMNBL website (www.trevali.com) will serve as an electronic method for First Nations to access Project documents, view maps, and send comments.
- In addition, an electronic or paper copy of the EIA Registration document will be provided to any other First Nations community requesting it.

Table 7.1 List of First Nation Communities and Groups

Mi'gmawe'l Tplu'taqnn Incorporated (MTI) Contact: Samantha Robichaud 40 Micmac Road Eel Ground, NB E1V 4B1 Tel.: (506) 455-1881 or (506) 627-4696	Pabineau First Nation Chief: David Peter-Paul 1290 Pabineau Falls Road Pabineau First Nation, NB E2A 7M3 Tel.: (506) 548-9211
Eel River Bar First Nation Chief: Thomas (Everett) Martin 11 Main Street, Unit 201 Eel River Bar, NB E8C 1A1 Tel.: (506) 684-6277	Esgenoôpetitj First Nation Chief: Alvery Paul 620 Bayview Drive Burnt Church, NB E9G 2A8 Tel.: (506) 776-1200
Eel Ground First Nation Chief: George Ginnish 47 Church Road Eel Ground, NB E1V 4E6 Tel.: (506) 627-4600	Metepenagiag Mi'kmaq Nation Chief: William (Bill) Ward P.O. Box 293 Metepenagiag Mi'kmaq Nation, NB E9E 2P2 Tel.: (506) 836-6111
Elsipogtog First Nation Chief: Arren Sock 373 Big Cove Road Elsipogtog First Nation, NB E4W 2S3 Tel.: (506) 523-8200	Kopit Lodge Consultation Coordinator: Kenneth Francis 33 Riverside Drive Elsipogtog First Nation, NB E4W 2Y6 Tel.: (506) 338-0125
Indian Island First Nation Chief: Kenneth Barlow 61 Indian Island Drive Indian Island, NB E4W 1S9 Tel.: (506) 523-8100	Bouctouche First Nation Chief: Ann Mary Steele 9 Reserve Road Bouctouche Reserve, NB E4S 4G2 Tel.: (506) 743-2520
Fort Folly First Nation Chief: Rebecca Knockwood P.O. Box 1007 Dorchester, NB E4K 3V5 Tel.: (506) 379-3400	Wolastoqey Nation in New Brunswick (WNNB) Executive Director of Consultation: Shyla O'Donnell 150 Cliffe Street, 2nd Floor, Box 14 Kchikhusis Commercial Centre St. Mary's First Nation, NB E3A 0A1 Tel.: (506)-459-6341
Madawaska Maliseet First Nation Chief: Patricia Bernard 1771 Main Street Madawaska Maliseet First Nation, NB E7C 1W9 Tel.: (506) 739-9765	Tobique First Nation Chief: Ross Perley 13094 Route 105 Tobique First Nation, NB, E7H 3Y4 Tel.: (506) 273-5560

Table 7.1 List of First Nation Communities and Groups

Woodstock First Nation Chief: Tim Paul 3 Wulastook Court Woodstock, NB, E7M 4K6 Tel.: (506) 323-3303	Kingsclear First Nation Chief: Gabriel Atwin 77 French Village Road Kingsclear First Nation, NB E3E 1K3 Tel.: (506) 363-3028
Saint Mary's Chief: Allen Polchies Jr. 150 Cliffe Street Fredericton, NB, E3A 0A1 Tel.: (506) 458-9511	Oromocto First Nation Chief: Shelley Sabattis P.O. Box 417 Oromocto, NB E2V 2J2 Tel.: (506) 357-2083

7.3 ISSUES TRACKING AND REPORTING

A major effort of the Indigenous engagement program will be to track, synthesize, and present comments to the applicable regulatory agencies. TMNBL will maintain a database used to track issues and concerns raised during the Indigenous engagement processes. The database will provide Project staff with the ability to conduct queries, print specific reports, and review the status of all issues, concerns or commitments.

Issues or concerns raised by, or commitments made to Indigenous groups will be entered into the database and monitored regularly during Project meetings until appropriate actions have taken place. During meetings, outstanding items will be reviewed and updates provided by the Project team. Upon completion of each outstanding item, the necessary information will be forwarded to administrative support personnel in order to identify the item as "complete".

Results of the Indigenous engagement activities conducted will be reported to the NBDELG, as per documentation requirements in NBDELG (2018).

8.0 PUBLIC INVOLVEMENT

The key elements of the public involvement program to be initiated for this Project are presented below. This program will fulfill the public involvement requirements of the New Brunswick *Environmental Impact Assessment Regulation* under the *Clean Environment Act* and the "Guide to Environmental Impact Assessment in New Brunswick" (NBDELG 2018c).

8.1 OBJECTIVES

The objectives of the public involvement program will be to:

- Provide information directly to the general public, stakeholders, community groups and other interested parties on the proposed Project;
- Provide information directly to elected officials and local service districts;
- Address issues and concerns raised during this process;
- Identify measures that will mitigate or resolve any public issues or concerns; and
- Identify proposed future consultation initiatives.

8.2 COMMUNICATION METHODS

The methods to be employed to communicate with affected property owners, stakeholders, and individuals are described below:

- **Information Package** – Bilingual information packages will be used to provide all interested parties with basic information about the Project. The package will include a cover letter addressed to the various stakeholders and fact sheets on the proposed undertaking.
- **Meetings with Stakeholders** – Information packages will be sent to elected officials, and representatives of relevant key organizations or interest groups in the local area (Table 8.1). An offer to meet will be extended to each key stakeholder group.
- **Web Postings** – The TMNBL website (www.trevali.com) will serve as an electronic method for members of the public to access Project documents, view maps, and send comments.
- **Public Notice** – An electronic copy of the EIA registration document will be made available on the NBDELG website (http://www2.gnb.ca/content/gnb/en/departments/elg/environment/content/environmental_impactassessment/registrations.html), and a paper copy will be made available for viewing during the public review period at the following locations:
  - NBDELG Bathurst Regional Office
  - NBDELG, Project and Approvals Branch (Fredericton)
  - The general public will be encouraged to forward comments and concerns to Project personnel.
- **Open House –** One public open house is planned to share information about the Project. Advertising in local newspapers and radio stations will be used to notify the public of the open house and provide them with an opportunity to learn more about the Project. Prior to the open house, a mail out (e.g., information package) will be sent to stakeholders. Further open houses may be considered during the EIA review period, if required.
- **Summary Report –** A brief summary report on the public notification initiatives carried out, and the key issues raised by the public during the EIA review, will be provided to NBDELG within 60 days following registration

Table 8.1 List of Key Groups, Stakeholders and Organizations

New Brunswick Department of Environment and Local Government Marysville Place P. O. Box 6000 Fredericton, NB E3B 5H1 Tel.: (506) 453-2690 (General Information)	**New Brunswick Department of Environment and Local Government – Bathurst Local Services** Bathurst Local Services Regional Office 159 Main Street, Room: 202 Bathurst, New Brunswick, E2A 1A6 Tel.: (506) 547-7443
New Brunswick Department of Energy and Resource Development Hugh John Flemming Forestry Centre P.O. Box 6000 Fredericton, NB E3B 5H1 Tel: (506) 453-3826	**Aboriginal Affairs Secretariat, Province of New Brunswick** Kings Place, Room: 237, King Tower Floor: P. O. Box 6000 Fredericton, NB E3B 5H1 Tel.: (506) 462-5177
New Brunswick Department of Tourism, Heritage and Culture Centennial Building P.O. Box 6000 Fredericton, NB E3B 5H1 Tel: (506) 453-3115	**New Brunswick Department of Agriculture, Aquaculture and Fisheries** Agricultural Research Station (Experimental Farm) P.O. Box 6000 Fredericton, NB E3B 5H1 Tel: (506) 453-2666
Conservation Council of New Brunswick 180 St. John Street Fredericton, NB E3B 4A9 Tel: (506) 458-8747 Email: info@conservationcouncil.ca	**New Brunswick Wildlife Federation** P.O. Box 549 Moncton, NB E1C 8L9 Tel: (506) 386-3144 Email: cleblan618@rogers.com
Nature New Brunswick (New Brunswick Federation of Naturalists) 924 Prospect Street, Suite 110 Fredericton, NB E3B 2T9 Tel: (506) 459-4209 Email: nbfn@nb.aibn.com	**Atlantic Salmon Federation** P.O. Box 5200 St. Andrews, NB E5B 3S8 Tel: (506) 529-4581 Email: savesalmon@asf.ca
Restigouche Regional Service Commission 68A Water Street Campbellton, New Brunswick E3N 1B1 Tel: (506) 789-2595 Email: info@commissionrestigouche.ca	**Nepisiguit Salmon Association** PO Box 871 Bathurst, NB E2A 4H7 Email: wayne.clowater@gmail.com
Provincial MLA Hon. Gilles LePage (Liberal) Constituency Office: Restigouche West 512 Des Pionniers Avenue Balmoral, NB E8E 1E3 Tel: (506) 826-6120 Email: Gilles.LePage@gnb.ca	**Federal MP** René Arseneault (Liberal) Madawaska - Restigouche 19 Aberdeen Street (Main Office), Suite 204 Campbellton, NB E3N 3G4 Tel.: (506) 789-4593 Email: Rene.Arseneault@parl.gc.ca

Table 8.1 List of Key Groups, Stakeholders and Organizations

Provincial MLA Hon. Lisa Harris (Liberal) Constituency Office: Miramichi Bay - Neguac 1 Marina Drive Miramichi, NB E1V 6S8 Tel: (506) 778-8713 Email: Lisa.Harris@gnb.ca	**Provincial MLA** Hon. Brian Kenny (Liberal) Constituency Office: Bathurst West - Beresford 325 Vanier Blvd, Suite 5 Bathurst, NB E2A 3N1 Tel: (506) 549-5355 Email: Brian.Kenny@gnb.ca

8.3 ISSUES TRACKING AND REPORTING

A major effort of the public engagement program will be to track, synthesize and present comments to the applicable regulatory agencies. For this Project, TMNBL will maintain a database that is used to track issues and concerns raised during the Project. The database will provide project staff with the ability to conduct queries, print specific reports and review the status of all issues, concerns and commitments.

Issues or concerns raised by, or commitments made to, affected landowners and stakeholders will be entered into the database and monitored regularly during project meetings until appropriate actions have been taken to address them. During any meetings, outstanding items will be reviewed and updates provided to the project team. Upon resolution of each outstanding item, the item will be identified as 'complete' in the database.

As required by the "Guide to Environmental Impact Assessment in New Brunswick", a summary report of public involvement activities conducted, key issues and concerns raised, and how they were or will be addressed, will be provided to the NBDELG within 60 days of registration.

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9.2 PERSONAL COMMUNICATIONS

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Connell, Chris. Personal communication, July 12, 2017. Unpublished data. Biologist, New Brunswick Department of Energy and Resource Development, Fredericton, New Brunswick.

Essalhi, Aziz. Personal communication, March 15, 2018. Environmental Coordinator with Trevali Mining (New Brunswick) Ltd., Bathurst, New Brunswick.

Gagnon, Luc. Personal communication, March 15, 2018. Regional Biologist, New Brunswick Department of Energy and Resource Development, Bathurst, New Brunswick.

Jarratt, Tricia. Personal communication, February 15, 2018. Manager, Archaeological Services Branch, New Brunswick Department of Tourism, Heritage and Culture, Fredericton, New Brunswick

Appendix A AC CDC DATA REPORT 6013: CARIBOU DEPOT, NB

Atlantic Canada Conservation Data Centre
Centre de données sur la conservation du Canada atlantique

DATA REPORT 6013: Caribou Depot, NB

Prepared 9 February 2018
by J. Churchill, Data Manager

CONTENTS OF REPORT

Map 1. A 100 km buffer around the study area

1.0 PREFACE

The Atlantic Canada Conservation Data Centre (ACCDC) 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 ACCDC 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 ACCDC is supported by 6 federal agencies and 4 provincial governments, as well as through outside grants and data processing fees. URL: www.ACCDC.com.

Upon request and for a fee, the ACCDC 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 ACCDC 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
CaribouDepotNB_6013ob.xls	All Rare and legally protected *Flora and Fauna* in your study area
CaribouDepotNB_6013ob100km.xls	A list of Rare and legally protected *Flora and Fauna* within 100 km of your study area
CaribouDepotNB_6013ob bb.xls	Common Breeding Birds in your study area

1.2 RESTRICTIONS

The ACCDC 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 ACCDC 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 ACCDC 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) ACCDC 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) ACCDC 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 ACCDC data response.

1.3 ADDITIONAL INFORMATION

The attached file DataDictionary 2.1.pdf provides metadata for the data provided.

Please direct any additional questions about ACCDC data to the following individuals:

Plants, Lichens, Ranking Methods, All other Inquiries
Sean Blaney, Senior Scientist, Executive Director
Tel: (506) 364-2658
sblaney@mta.ca

Animals (Fauna)
John Klymko, Zoologist
Tel: (506) 364-2660
jklymko@mta.ca

Plant Communities
Sarah Robinson, Community Ecologist
Tel: (506) 364-2664
srobinson@mta.ca

Data Management, GIS
James Churchill, Data Manager
Tel: (902) 679-6146
jlchurchill@mta.ca

Billing
Jean Breau
Tel: (506) 364-2657
jrbreau@mta.ca

Questions on the biology of Federal Species at Risk can be directed to ACCDC: (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 Stewart Lusk, Natural Resources: (506) 453-7110.

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 Sherman Boates, NSDNR: (902) 679-6146. To determine if location-sensitive species (section 4.3) occur near your study site please contact a NSDNR Regional Biologist:

Western: Duncan Bayne
(902) 648-3536
Duncan.Bayne@novascotia.ca

Western: Jason Power
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(902) 893-6353
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Eastern: Lisa Doucette
(902) 863-7523
Lisa.Doucette@novascotia.ca

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

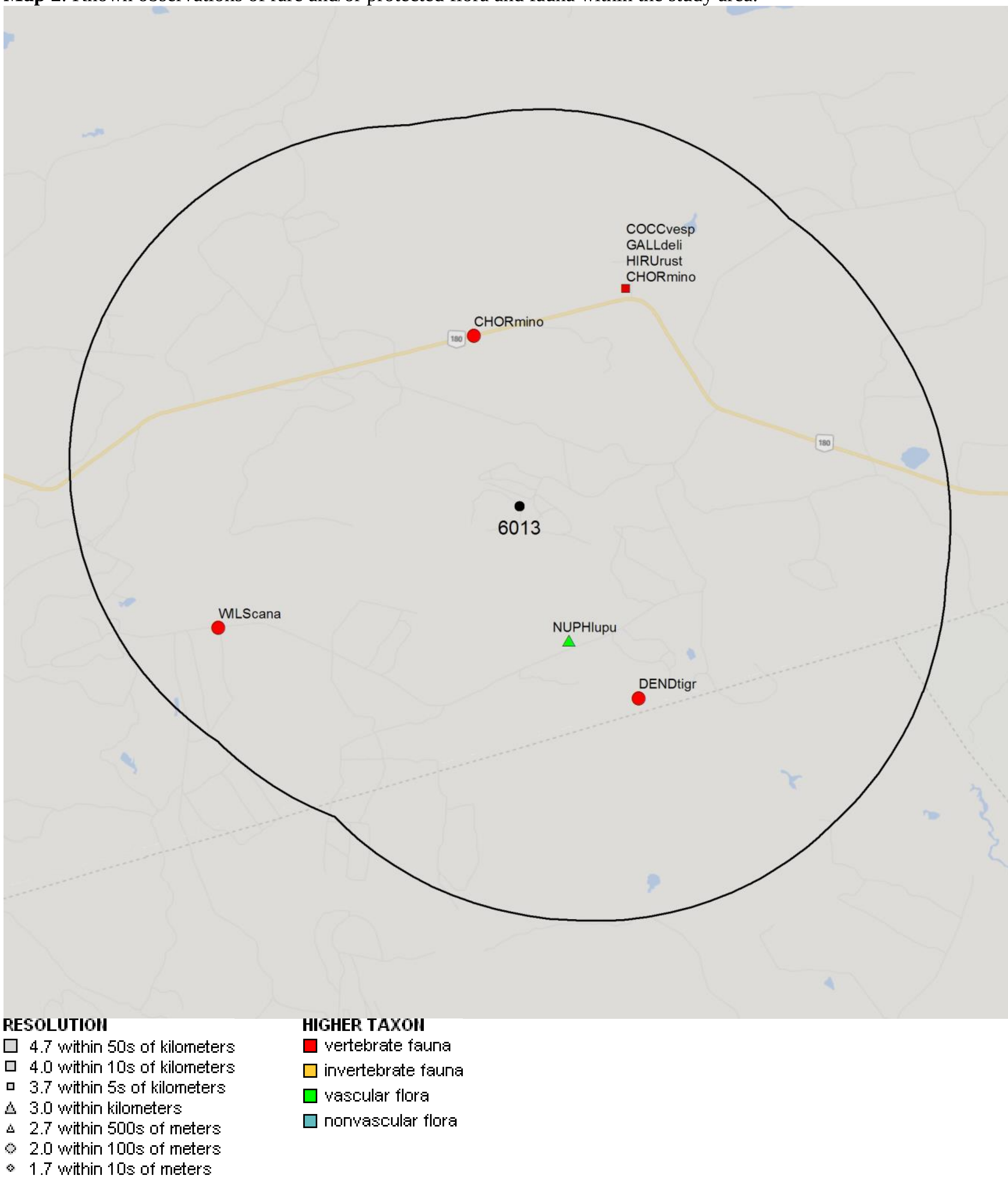
For provincial information about rare taxa and protected areas, or information about game animals, fish habitat etc., in Prince Edward Island, please contact Garry Gregory, PEI Dept. of Communities, Land and Environment: (902) 569-7595.

2.0 RARE AND ENDANGERED SPECIES

2.1 FLORA
The study area contains 1 record of 1 vascular, no records of nonvascular flora (Map 2 and attached: *ob.xls).

2.2 FAUNA
The study area contains 7 records of 6 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.

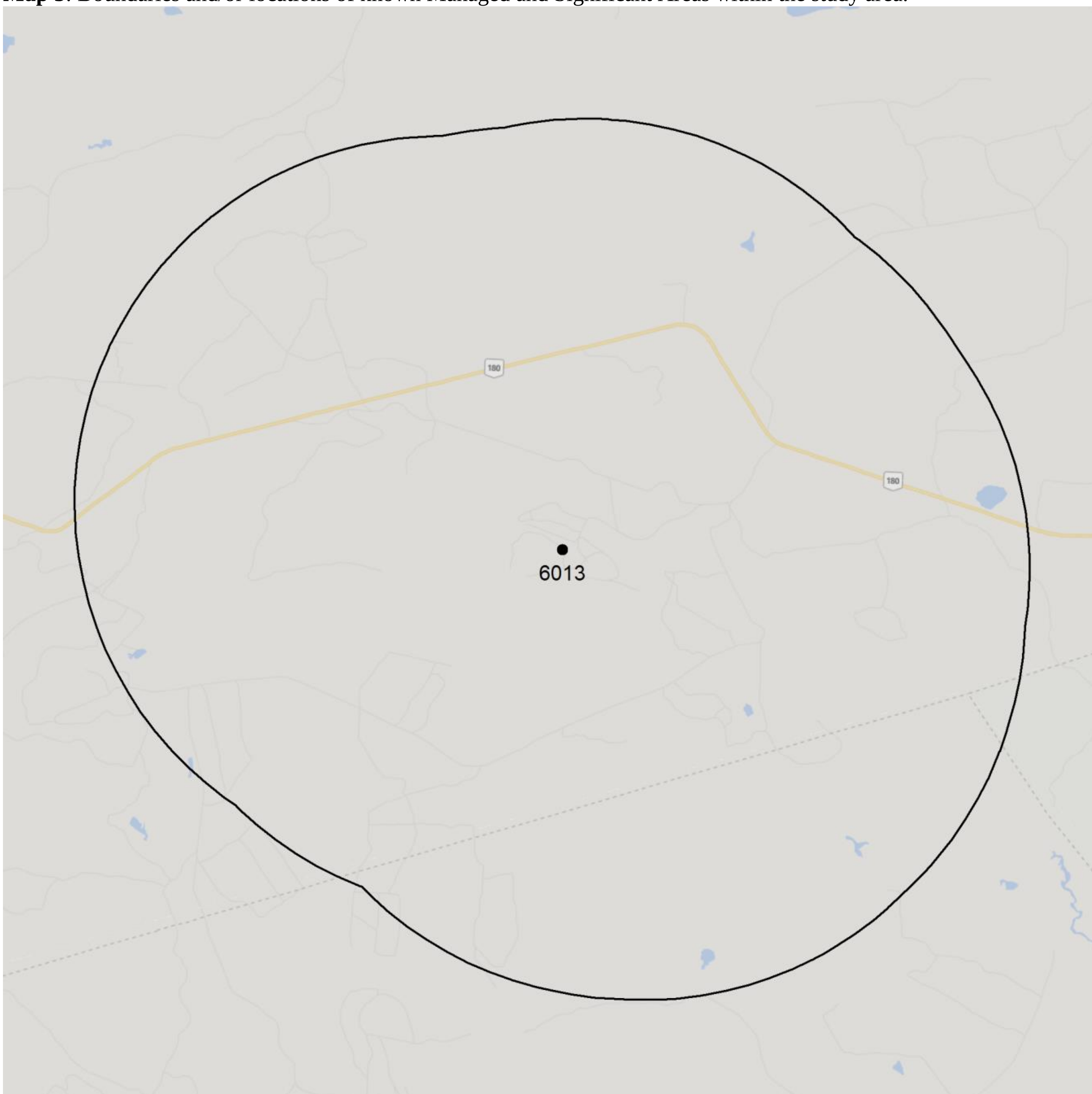


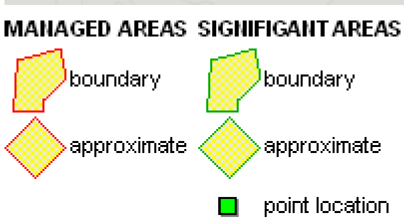
3.0 SPECIAL AREAS

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 no biologically significant sites in the vicinity of the study area (Map 3).

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)
P	*Nuphar lutea ssp. pumila*	Small Yellow Pond-lily				S3	4 Secure	1	2.1 ± 1.0

4.2 FAUNA

	Scientific *Name*	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)
A	*Hirundo rustica*	Barn Swallow	Threatened	Threatened	Threatened	S2B,S2M	3 Sensitive	1	3.6 ± 7.0
A	*Wilsonia canadensis*	Canada Warbler	Threatened	Threatened	Threatened	S3B,S3M	1 At Risk	1	4.8 ± 0.0
A	*Chordeiles minor*	Common Nighthawk	Threatened	Threatened	Threatened	S3B,S4M	1 At Risk	2	2.6 ± 0.0
A	*Coccothraustes vespertinus*	Evening Grosbeak	Special Concern			S3B,S3S4N,SUM	3 Sensitive	1	3.6 ± 7.0
A	*Dendroica tigrina*	Cape May Warbler				S3B,S4S5M	4 Secure	1	3.4 ± 0.0
A	*Gallinago delicata*	Wilson's Snipe				S3S4B,S5M	4 Secure	1	3.6 ± 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	No
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 ACCDC and the data sources listed below in any documents, reports, publications or presentations, in which this dataset makes a significant contribution.

# recs	CITATION
5	Lepage, D. 2014. Maritime Breeding Bird Atlas Database. Bird Studies Canada, Sackville NB, 407,838 recs.
2	Erskine, A.J. 1992. Maritime Breeding Bird Atlas Database. NS Museum & Nimbus Publ., Halifax, 82,125 recs.
1	Clayden, S.R. 1998. NBM Science Collections databases: vascular plants. New Brunswick Museum, Saint John NB, 19759 recs.

5.0 RARE SPECIES WITHIN 100 KM

A 100 km buffer around the study area contains 11631 records of 121 vertebrate and 486 records of 44 invertebrate fauna; 5481 records of 296 vascular, 281 records of 106 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. 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	1	49.0 ± 1.0	NB
A	*Myotis septentrionalis*	Northern Long-eared Myotis	Endangered	Endangered	Endangered	S1	1 At Risk	2	74.6 ± 1.0	NB
A	*Charadrius melodus melodus*	Piping Plover melodus ssp	Endangered	Endangered	Endangered	S1B,S1M	1 At Risk	21	47.9 ± 0.0	NB
A	*Dermochelys coriacea (Atlantic pop.)*	Leatherback Sea Turtle - Atlantic pop.	Endangered	Endangered	Endangered	S1S2N	1 At Risk	1	98.2 ± 1.0	NB
A	*Salmo salar pop. 1*	Atlantic Salmon - Inner Bay of Fundy pop.	Endangered	Endangered	Endangered	S2	2 May Be At Risk	153	93.5 ± 0.0	NB
A	*Calidris canutus rufa*	Red Knot rufa ssp	Endangered		Endangered	S2M	1 At Risk	9	46.9 ± 0.0	NB
A	*Rangifer tarandus pop. 2*	Woodland Caribou (Atlantic-Gasp├⌐sie pop.)	Endangered	Endangered	Extirpated	SX	0.1 Extirpated	5	10.1 ± 5.0	NB
A	*Emydoidea blandingii*	Blanding's Turtle - Nova Scotia pop.	Endangered	Endangered				1	62.0 ± 1.0	NB
A	*Sturnella magna*	Eastern Meadowlark	Threatened	Threatened	Threatened	S1B,S1M	2 May Be At Risk	5	83.1 ± 7.0	NB
A	*Ixobrychus exilis*	Least Bittern	Threatened	Threatened	Threatened	S1S2B,S1S2M	1 At Risk	1	25.6 ± 0.0	NB
A	*Hylocichla mustelina*	Wood Thrush	Threatened	Threatened	Threatened	S1S2B,S1S2M	2 May Be At Risk	57	23.0 ± 7.0	NB
A	*Caprimulgus vociferus*	Whip-Poor-Will	Threatened	Threatened	Threatened	S2B,S2M	1 At Risk	30	71.5 ± 7.0	NB
A	*Hirundo rustica*	Barn Swallow	Threatened	Threatened	Threatened	S2B,S2M	3 Sensitive	433	3.6 ± 7.0	NB
A	*Catharus bicknelli*	Bicknell's Thrush	Threatened	Special Concern	Threatened	S2B,S2M	1 At Risk	557	10.9 ± 7.0	NB
A	*Glyptemys insculpta*	Wood Turtle	Threatened	Threatened	Threatened	S2S3	1 At Risk	41	44.5 ± 0.0	NB
A	*Chaetura pelagica*	Chimney Swift	Threatened	Threatened	Threatened	S2S3B,S2M	1 At Risk	214	19.8 ± 7.0	NB
A	*Riparia riparia*	Bank Swallow	Threatened	Threatened		S2S3B,S2S3M	3 Sensitive	181	19.8 ± 7.0	NB
A	*Contopus cooperi*	Olive-sided Flycatcher	Threatened	Threatened	Threatened	S3B,S3M	1 At Risk	476	10.9 ± 7.0	NB
A	*Wilsonia canadensis*	Canada Warbler	Threatened	Threatened	Threatened	S3B,S3M	1 At Risk	425	4.8 ± 0.0	NB
A	*Dolichonyx oryzivorus*	Bobolink	Threatened	Threatened	Threatened	S3B,S3M	3 Sensitive	328	19.6 ± 7.0	NB
A	*Chordeiles minor*	Common Nighthawk	Threatened	Threatened	Threatened	S3B,S4M	1 At Risk	327	2.6 ± 0.0	NB
A	*Anguilla rostrata*	American Eel	Threatened		Threatened	S4	4 Secure	10	10.5 ± 0.0	NB
A	*Coturnicops noveboracensis*	Yellow Rail	Special Concern	Special Concern	Special Concern	S1?B,SUM	2 May Be At Risk	2	51.7 ± 0.0	NB
A	*Histrionicus histrionicus pop. 1*	Harlequin Duck - Eastern pop.	Special Concern	Special Concern	Endangered	S1B,S1S2N,S2M	1 At Risk	6	20.1 ± 7.0	NB
A	*Falco peregrinus pop. 1*	Peregrine Falcon - anatum/tundrius	Special Concern	Special Concern	Endangered	S1B,S3M	1 At Risk	3	88.3 ± 0.0	NB
A	*Asio flammeus*	Short-eared Owl	Special Concern	Special Concern	Special Concern	S2B,S2M	3 Sensitive	4	46.9 ± 0.0	NB
A	*Bucephala islandica (Eastern pop.)*	Barrow's Goldeneye - Eastern pop.	Special Concern	Special Concern	Special Concern	S2M,S2N	3 Sensitive	21	48.0 ± 0.0	NB
A	*Euphagus carolinus*	Rusty Blackbird	Special Concern	Special Concern	Special Concern	S3B,S3M	2 May Be At Risk	196	10.9 ± 7.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
A	*Coccothraustes vespertinus*	Evening Grosbeak	Special Concern			S3B,S3S4N,SUM	3 Sensitive	458	3.6 ± 7.0	NB
A	*Phocoena phocoena (NW Atlantic pop.)*	Harbour Porpoise - Northwest Atlantic pop.	Special Concern	Threatened		S4		1	58.5 ± 1.0	NB
A	*Contopus virens*	Eastern Wood-Pewee	Special Concern	Special Concern	Special Concern	S4B,S4M	4 Secure	296	11.8 ± 7.0	NB
A	*Podiceps auritus*	Horned Grebe	Special Concern		Special Concern	S4N,S4M	4 Secure	1	55.6 ± 0.0	NB
A	*Tryngites subruficollis*	Buff-breasted Sandpiper	Special Concern			SNA	8 Accidental	1	98.4 ± 0.0	NB
A	*Odobenus rosmarus rosmarus*	Atlantic Walrus	Special Concern		Extirpated	SX		1	87.2 ± 1.0	NB
A	*Bubo scandiacus*	Snowy Owl	Not At Risk			S1N,S2S3M	4 Secure	5	42.8 ± 1.0	NB
A	*Accipiter cooperii*	Cooper's Hawk	Not At Risk			S1S2B,S1S2M	2 May Be At Risk	3	52.4 ± 0.0	NB
A	*Fulica americana*	American Coot	Not At Risk			S1S2B,S1S2M	3 Sensitive	1	88.0 ± 1.0	NB
A	*Aegolius funereus*	Boreal Owl	Not At Risk			S1S2B,SUM	2 May Be At Risk	10	26.7 ± 7.0	NB
A	*Sorex dispar*	Long-tailed Shrew	Not At Risk	Special Concern		S2	3 Sensitive	22	47.4 ± 1.0	NB
A	*Buteo lineatus*	Red-shouldered Hawk	Not At Risk	Special Concern		S2B,S2M	2 May Be At Risk	7	59.0 ± 7.0	NB
A	*Globicephala melas*	Long-finned Pilot Whale	Not At Risk			S2S3		1	95.4 ± 1.0	NB
A	*Lynx canadensis*	Canadian Lynx	Not At Risk		Endangered	S3	1 At Risk	50	12.4 ± 0.0	NB
A	*Sterna hirundo*	Common Tern	Not At Risk			S3B,SUM	3 Sensitive	112	25.6 ± 0.0	NB
A	*Podiceps grisegena*	Red-necked Grebe	Not At Risk			S3M,S2N	3 Sensitive	2	55.6 ± 0.0	NB
A	*Haliaeetus leucocephalus*	Bald Eagle	Not At Risk		Endangered	S4	1 At Risk	256	16.7 ± 7.0	NB
A	*Puma concolor pop. 1*	Eastern Cougar	Data Deficient		Endangered	SU	5 Undetermined	32	14.4 ± 1.0	NB
A	*Morone saxatilis*	Striped Bass	E,E,SC			S3	2 May Be At Risk	7	80.3 ± 10.0	NB
A	*Salvelinus alpinus*	Arctic Char				S1	3 Sensitive	10	17.1 ± 1.0	NB
A	*Synaptomys borealis*	Northern Bog Lemming				S1	5 Undetermined	4	25.0 ± 1.0	NB
A	*Tringa melanoleuca*	Greater Yellowlegs				S1?B,S5M	4 Secure	194	25.6 ± 0.0	NB
A	*Bartramia longicauda*	Upland Sandpiper				S1B,S1M	3 Sensitive	4	93.0 ± 7.0	NB
A	*Phalaropus tricolor*	Wilson's Phalarope				S1B,S1M	3 Sensitive	1	89.7 ± 1.0	NB
A	*Progne subis*	Purple Martin				S1B,S1M	2 May Be At Risk	3	19.8 ± 7.0	NB
A	*Thryothorus ludovicianus*	Carolina Wren				S1B,S1M	8 Accidental	3	38.2 ± 0.0	NB
A	*Oxyura jamaicensis*	Ruddy Duck				S1B,S2S3M	4 Secure	2	58.7 ± 8.0	NB
A	*Uria aalge*	Common Murre				S1B,S3N,S3M	4 Secure	2	82.2 ± 0.0	NB
A	*Aythya affinis*	Lesser Scaup				S1B,S4M	4 Secure	18	46.4 ± 0.0	NB
A	*Aythya marila*	Greater Scaup				S1B,S4M,S2N	4 Secure	1	98.5 ± 1.0	NB
A	*Eremophila alpestris*	Horned Lark				S1B,S4N,S5M	2 May Be At Risk	27	12.4 ± 0.0	NB
A	*Sterna paradisaea*	Arctic Tern				S1B,SUM	2 May Be At Risk	6	50.9 ± 0.0	NB
A	*Branta bernicla*	Brant				S1N, S2S3M	4 Secure	9	47.3 ± 10.0	NB
A	*Nycticorax nycticorax*	Black-crowned Night-heron				S1S2B,S1S2M	3 Sensitive	47	32.1 ± 1.0	NB
A	*Empidonax traillii*	Willow Flycatcher				S1S2B,S1S2M	3 Sensitive	9	23.4 ± 7.0	NB
A	*Stelgidopteryx serripennis*	Northern Rough-winged Swallow				S1S2B,S1S2M	2 May Be At Risk	4	12.4 ± 0.0	NB
A	*Troglodytes aedon*	House Wren				S1S2B,S1S2M	5 Undetermined	6	44.4 ± 0.0	NB
A	*Rissa tridactyla*	Black-legged Kittiwake				S1S2B,S4N,S5M	4 Secure	22	50.9 ± 0.0	NB
A	*Calidris bairdii*	Baird's Sandpiper				S1S2M	3 Sensitive	3	91.1 ± 0.0	NB
A	*Microtus chrotorrhinus*	Rock Vole				S2?	5 Undetermined	30	49.0 ± 1.0	NB
A	*Mimus polyglottos*	Northern Mockingbird				S2B,S2M	3 Sensitive	33	42.6 ± 7.0	NB
A	*Toxostoma rufum*	Brown Thrasher				S2B,S2M	3 Sensitive	20	39.2 ± 0.0	NB
A	*Pooecetes gramineus*	Vesper Sparrow				S2B,S2M	2 May Be At Risk	40	24.8 ± 0.0	NB
A	*Anas strepera*	Gadwall				S2B,S3M	4 Secure	7	52.4 ± 0.0	NB
A	*Alca torda*	Razorbill				S2B,S3N,S3M	4 Secure	9	44.8 ± 7.0	NB
A	*Pinicola enucleator*	Pine Grosbeak				S2B,S4S5N,S4S5M	3 Sensitive	95	8.1 ± 7.0	NB
A	*Tringa solitaria*	Solitary Sandpiper				S2B,S5M	4 Secure	43	33.2 ± 6.0	NB
A	*Chen caerulescens*	Snow Goose				S2M	4 Secure	6	55.6 ± 0.0	NB
A	*Phalacrocorax carbo*	Great Cormorant				S2N,S2M	4 Secure	2	48.1 ± 0.0	NB
A	*Larus hyperboreus*	Glaucous Gull				S2N,S2M	4 Secure	6	48.5 ± 5.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
A	*Asio otus*	Long-eared Owl				S2S3	5 Undetermined	14	51.3 ± 0.0	NB
A	*Picoides dorsalis*	American Three-toed Woodpecker				S2S3	3 Sensitive	72	21.3 ± 0.0	NB
A	*Salmo salar*	Atlantic Salmon				S2S3	2 May Be At Risk	2103	21.2 ± 50.0	NB
A	*Anas clypeata*	Northern Shoveler				S2S3B,S2S3M	4 Secure	22	44.2 ± 7.0	NB
A	*Myiarchus crinitus*	Great Crested Flycatcher				S2S3B,S2S3M	3 Sensitive	23	19.0 ± 7.0	NB
A	*Petrochelidon pyrrhonota*	Cliff Swallow				S2S3B,S2S3M	3 Sensitive	231	19.8 ± 7.0	NB
A	*Pluvialis dominica*	American Golden-Plover				S2S3M	3 Sensitive	9	48.9 ± 0.0	NB
A	*Calcarius lapponicus*	Lapland Longspur				S2S3N,SUM	3 Sensitive	1	88.4 ± 0.0	NB
A	*Cepphus grylle*	Black Guillemot				S3	4 Secure	62	25.6 ± 0.0	NB
A	*Loxia curvirostra*	Red Crossbill				S3	4 Secure	56	11.8 ± 7.0	NB
A	*Carduelis pinus*	Pine Siskin				S3	4 Secure	269	6.8 ± 7.0	NB
A	*Prosopium cylindraceum*	Round Whitefish				S3	4 Secure	4	64.0 ± 0.0	NB
A	*Salvelinus namaycush*	Lake Trout				S3	3 Sensitive	5	64.7 ± 0.0	NB
A	*Cathartes aura*	Turkey Vulture				S3B,S3M	4 Secure	18	25.0 ± 7.0	NB
A	*Rallus limicola*	Virginia Rail				S3B,S3M	3 Sensitive	10	52.0 ± 7.0	NB
A	*Charadrius vociferus*	Killdeer				S3B,S3M	3 Sensitive	350	6.8 ± 7.0	NB
A	*Tringa semipalmata*	Willet				S3B,S3M	3 Sensitive	33	25.6 ± 0.0	NB
A	*Coccyzus erythropthalmus*	Black-billed Cuckoo				S3B,S3M	4 Secure	33	42.6 ± 0.0	NB
A	*Vireo gilvus*	Warbling Vireo				S3B,S3M	4 Secure	55	33.2 ± 5.0	NB
A	*Piranga olivacea*	Scarlet Tanager				S3B,S3M	4 Secure	86	11.2 ± 0.0	NB
A	*Passerina cyanea*	Indigo Bunting				S3B,S3M	4 Secure	12	75.2 ± 7.0	NB
A	*Molothrus ater*	Brown-headed Cowbird				S3B,S3M	2 May Be At Risk	105	12.4 ± 0.0	NB
A	*Icterus galbula*	Baltimore Oriole				S3B,S3M	4 Secure	63	40.9 ± 7.0	NB
A	*Somateria mollissima*	Common Eider				S3B,S4M,S3N	4 Secure	65	25.6 ± 0.0	NB
A	*Dendroica tigrina*	Cape May Warbler				S3B,S4S5M	4 Secure	197	3.4 ± 0.0	NB
A	*Anas acuta*	Northern Pintail				S3B,S5M	3 Sensitive	32	48.9 ± 1.0	NB
A	*Mergus serrator*	Red-breasted Merganser				S3B,S5M,S4S5N	4 Secure	70	31.6 ± 7.0	NB
A	*Arenaria interpres*	Ruddy Turnstone				S3M	4 Secure	148	46.9 ± 0.0	NB
A	*Phalaropus fulicarius*	Red Phalarope				S3M	3 Sensitive	2	91.1 ± 0.0	NB
A	*Melanitta nigra*	Black Scoter				S3M,S1S2N	3 Sensitive	46	47.3 ± 12.0	NB
A	*Bucephala albeola*	Bufflehead				S3M,S2N	3 Sensitive	20	48.0 ± 0.0	NB
A	*Calidris maritima*	Purple Sandpiper				S3M,S3N	4 Secure	4	48.9 ± 0.0	NB
A	*Tyrannus tyrannus*	Eastern Kingbird				S3S4B,S3S4M	3 Sensitive	169	6.8 ± 7.0	NB
A	*Actitis macularius*	Spotted Sandpiper				S3S4B,S5M	4 Secure	716	6.8 ± 7.0	NB
A	*Gallinago delicata*	Wilson's Snipe				S3S4B,S5M	4 Secure	256	3.6 ± 7.0	NB
A	*Larus delawarensis*	Ring-billed Gull				S3S4B,S5M	4 Secure	203	12.4 ± 0.0	NB
A	*Dendroica striata*	Blackpoll Warbler				S3S4B,S5M	4 Secure	197	6.8 ± 7.0	NB
A	*Pluvialis squatarola*	Black-bellied Plover				S3S4M	4 Secure	41	48.9 ± 0.0	NB
A	*Limosa haemastica*	Hudsonian Godwit				S3S4M	4 Secure	6	48.9 ± 0.0	NB
A	*Calidris pusilla*	Semipalmated Sandpiper				S3S4M	4 Secure	217	46.7 ± 1.0	NB
A	*Calidris melanotos*	Pectoral Sandpiper				S3S4M	4 Secure	37	84.4 ± 0.0	NB
A	*Calidris alba*	Sanderling				S3S4M,S1N	3 Sensitive	84	47.2 ± 0.0	NB
A	*Morus bassanus*	Northern Gannet				SHB,S5M	4 Secure	43	25.6 ± 0.0	NB
I	*Coenonympha nipisiquit*	Maritime Ringlet	Endangered	Endangered	Endangered	S1	1 At Risk	38	44.2 ± 7.0	NB
I	*Danaus plexippus*	Monarch	Endangered	Special Concern	Special Concern	S3B,S3M	3 Sensitive	8	82.9 ± 0.0	NB
I	*Ophiogomphus howei*	Pygmy Snaketail	Special Concern	Special Concern	Special Concern	S2	2 May Be At Risk	13	98.0 ± 0.0	NB
I	*Bombus terricola*	Yellow-banded Bumblebee	Special Concern			S3?	3 Sensitive	9	29.9 ± 0.0	NB
I	*Erora laeta*	Early Hairstreak				S1	2 May Be At Risk	1	88.7 ± 7.0	NB
I	*Somatochlora septentrionalis*	Muskeg Emerald				S1	2 May Be At Risk	3	78.3 ± 0.0	NB
I	*Leucorrhinia patricia*	Canada Whiteface				S1	2 May Be At Risk	8	76.8 ± 1.0	NB
I	*Plebejus saepiolus*	Greenish Blue				S1S2	4 Secure	26	44.7 ± 1.0	NB
I	*Strymon melinus*	Grey Hairstreak				S2	4 Secure	7	51.1 ± 0.0	NB

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I	*Aeshna juncea*	Rush Darner				S2	3 Sensitive	13	28.7 ± 1.0	NB
I	*Somatochlora brevicincta*	Quebec Emerald				S2	5 Undetermined	6	85.8 ± 0.0	NB
I	*Somatochlora tenebrosa*	Clamp-Tipped Emerald				S2	5 Undetermined	3	51.0 ± 0.0	NB
I	*Coenagrion interrogatum*	Subarctic Bluet				S2	3 Sensitive	15	28.9 ± 1.0	NB
I	*Callophrys henrici*	Henry's Elfin				S2S3	4 Secure	4	65.4 ± 0.0	NB
I	*Desmocerus palliatus*	Elderberry Borer				S3		2	50.1 ± 5.0	NB
I	*Calathus gregarius*	a Ground Beetle				S3	4 Secure	1	46.9 ± 1.0	NB
I	*Hyperaspis disconotata*	a Ladybird Beetle				S3	5 Undetermined	1	50.5 ± 5.0	NB
I	*Euphyes bimacula*	Two-spotted Skipper				S3	4 Secure	4	56.1 ± 0.0	NB
I	*Papilio brevicauda*	Short-tailed Swallowtail				S3	4 Secure	26	44.2 ± 7.0	NB
I	*Papilio brevicauda bretonensis*	Short-tailed Swallowtail				S3	4 Secure	8	48.5 ± 1.0	NB
I	*Lycaena hyllus*	Bronze Copper				S3	3 Sensitive	2	88.0 ± 0.0	NB
I	*Lycaena dospassosi*	Salt Marsh Copper				S3	4 Secure	71	44.2 ± 7.0	NB
I	*Satyrium acadica*	Acadian Hairstreak				S3	4 Secure	3	51.1 ± 0.0	NB
I	*Callophrys polios*	Hoary Elfin				S3	4 Secure	6	60.4 ± 0.0	NB
I	*Callophrys eryphon*	Western Pine Elfin				S3	4 Secure	10	25.4 ± 0.0	NB
I	*Plebejus idas*	Northern Blue				S3	4 Secure	12	85.4 ± 7.0	NB
I	*Speyeria aphrodite*	Aphrodite Fritillary				S3	4 Secure	3	61.9 ± 1.0	NB
I	*Boloria eunomia*	Bog Fritillary				S3	5 Undetermined	9	59.8 ± 0.0	NB
I	*Boloria chariclea*	Arctic Fritillary				S3	4 Secure	16	33.5 ± 0.0	NB
I	*Boloria chariclea grandis*	Purple Lesser Fritillary				S3	4 Secure	4	59.5 ± 10.0	NB
I	*Polygonia satyrus*	Satyr Comma				S3	4 Secure	17	26.1 ± 0.0	NB
I	*Polygonia gracilis*	Hoary Comma				S3	4 Secure	28	38.2 ± 0.0	NB
I	*Nymphalis l-album*	Compton Tortoiseshell				S3	4 Secure	9	35.1 ± 0.0	NB
I	*Gomphus abbreviatus*	Spine-crowned Clubtail				S3	4 Secure	5	62.2 ± 0.0	NB
I	*Somatochlora albicincta*	Ringed Emerald				S3	4 Secure	34	15.8 ± 1.0	NB
I	*Somatochlora cingulata*	Lake Emerald				S3	4 Secure	27	11.9 ± 1.0	NB
I	*Somatochlora forcipata*	Forcipate Emerald				S3	4 Secure	14	36.1 ± 0.0	NB
I	*Lestes eurinus*	Amber-Winged Spreadwing				S3	4 Secure	6	61.6 ± 1.0	NB
I	*Stylurus scudderi*	Zebra Clubtail				S3	4 Secure	1	85.7 ± 0.0	NB
I	*Neohelix albolabris*	Whitelip				S3		1	52.6 ± 1.0	NB
I	*Pantala hymenaea*	Spot-Winged Glider				S3B,S3M	4 Secure	1	61.1 ± 1.0	NB
I	*Satyrium liparops*	Striped Hairstreak				S3S4	4 Secure	8	61.9 ± 1.0	NB
I	*Satyrium liparops strigosum*	Striped Hairstreak				S3S4	4 Secure	2	52.1 ± 0.0	NB
I	*Coccinella transversoguttata richardsoni*	Transverse Lady Beetle				SH	2 May Be At Risk	1	48.5 ± 1.0	NB
N	*Arctoa fulvella*	a Moss				S1	2 May Be At Risk	2	49.0 ± 1.0	NB
N	*Grimmia donniana*	Donn's Grimmia Moss				S1	2 May Be At Risk	4	48.7 ± 0.0	NB
N	*Grimmia incurva*	Black Grimmia				S1	2 May Be At Risk	4	48.7 ± 0.0	NB
N	*Kiaeria starkei*	Starke's Fork Moss				S1	2 May Be At Risk	1	49.0 ± 1.0	NB
N	*Pseudoleskeella tectorum*	Rooftop Leskea Moss				S1	2 May Be At Risk	1	54.2 ± 1.0	NB
N	*Syntrichia ruralis*	a Moss				S1	2 May Be At Risk	1	17.5 ± 0.0	NB
N	*Placynthium asperellum*	Lilliput Ink Lichen				S1		1	77.9 ± 0.0	NB
N	*Lathagrium auriforme*	a tarpaper lichen				S1		1	17.4 ± 0.0	NB
N	*Ephebe hispidula*	Dryside Rockshag Lichen				S1		1	34.2 ± 0.0	NB

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N	*Ephebe perspinulosa*	Thread Lichen				S1		2	33.7 ± 0.0	NB
N	*Leptogium intermedium*	Forty-five Jellyskin Lichen				S1		4	33.6 ± 0.0	NB
N	*Physconia leucoleiptes*	Bottle-brush Frost Lichen				S1		1	77.7 ± 0.0	NB
N	*Phaeophyscia hispidula*	Whiskered Shadow Lichen				S1		1	17.6 ± 0.0	NB
N	*Anastrophyllum saxicola*	Curled Notchwort				S1?	6 Not Assessed	1	55.5 ± 0.0	NB
N	*Bryum blindii*	a Moss				S1?	2 May Be At Risk	1	44.7 ± 1.0	NB
N	*Bryum pallens*	a Moss				S1?	2 May Be At Risk	1	83.7 ± 0.0	NB
N	*Cinclidium stygium*	Sooty Cupola Moss				S1?	2 May Be At Risk	1	47.4 ± 0.0	NB
N	*Tortula cernua*	Narrow-Leafed Chain-Teeth Moss				S1?	2 May Be At Risk	2	44.7 ± 1.0	NB
N	*Dicranum bonjeanii*	Bonjean's Broom Moss				S1?	2 May Be At Risk	1	50.9 ± 0.0	NB
N	*Paludella squarrosa*	Tufted Fen Moss				S1?	2 May Be At Risk	1	47.4 ± 0.0	NB
N	*Seligeria recurvata*	a Moss				S1?	2 May Be At Risk	5	33.6 ± 0.0	NB
N	*Splachnum sphaericum*	Round-fruited Dung Moss				S1?	3 Sensitive	1	88.5 ± 1.0	NB
N	*Rhizomnium pseudopunctatum*	Felted Leafy Moss				S1?	2 May Be At Risk	1	50.5 ± 1.0	NB
N	*Leptogium burnetiae*	Long-bearded Jellyskin Lichen				S1?		1	17.7 ± 0.0	NB
N	*Lophozia heterocolpos*	Whip Notchwort				S1S2	6 Not Assessed	2	37.9 ± 0.0	NB
N	*Metacalypogeia schusterana*	Schuster's Pouchwort				S1S2	6 Not Assessed	3	41.8 ± 0.0	NB
N	*Reboulia hemisphaerica*	Purple-margined Liverwort				S1S2	6 Not Assessed	2	17.2 ± 0.0	NB
N	*Calliergon richardsonii*	Richardson's Spear Moss				S1S2	2 May Be At Risk	3	51.1 ± 1.0	NB
N	*Campylium radicale*	Long-stalked Fine Wet Moss				S1S2	5 Undetermined	2	55.8 ± 10.0	NB
N	*Distichium inclinatum*	Inclined Iris Moss				S1S2	2 May Be At Risk	2	38.5 ± 1.0	NB
N	*Oncophorus virens*	Green Spur Moss				S1S2	2 May Be At Risk	1	82.0 ± 0.0	NB
N	*Platydictya confervoides*	a Moss				S1S2	3 Sensitive	4	33.7 ± 0.0	NB
N	*Seligeria brevifolia*	a Moss				S1S2	3 Sensitive	2	36.1 ± 0.0	NB
N	*Timmia austriaca*	Austrian Timmia Moss				S1S2	2 May Be At Risk	1	72.9 ± 10.0	NB
N	*Timmia norvegica var. excurrens*	a moss				S1S2	2 May Be At Risk	2	37.9 ± 0.0	NB
N	*Tomentypnum falcifolium*	Sickle-leaved Golden Moss				S1S2	2 May Be At Risk	1	78.7 ± 0.0	NB
N	*Anaptychia crinalis*	Hanging Fringed Lichen				S1S2	5 Undetermined	1	77.6 ± 0.0	NB
N	*Calypogeia neesiana*	Nees' Pouchwort				S1S3	6 Not Assessed	1	98.0 ± 1.0	NB
N	*Frullania selwyniana*	Selwyn's Scalewort				S1S3	6 Not Assessed	1	77.6 ± 0.0	NB
N	*Lophozia badensis*	Dwarf Notchwort				S1S3	6 Not Assessed	1	44.7 ± 1.0	NB
N	*Lophozia obtusa*	Obtuse Notchwort				S1S3	6 Not Assessed	2	52.0 ± 1.0	NB
N	*Fontinalis hypnoides*	a moss				S2	3 Sensitive	1	94.0 ± 15.0	NB
N	*Anomodon tristis*	a Moss				S2	2 May Be At Risk	1	77.9 ± 0.0	NB
N	*Hypnum pratense*	Meadow Plait Moss				S2	3 Sensitive	2	51.7 ± 0.0	NB
N	*Isopterygiopsis pulchella*	Neat Silk Moss				S2	3 Sensitive	2	36.8 ± 0.0	NB
N	*Meesia triquetra*	Three-ranked Cold Moss				S2	2 May Be At Risk	2	70.8 ± 10.0	NB
N	*Platydictya jungermannioides*	False Willow Moss				S2	3 Sensitive	1	53.8 ± 1.0	NB
N	*Pohlia elongata*	Long-necked Nodding Moss				S2	3 Sensitive	1	71.8 ± 2.0	NB
N	*Pohlia sphagnicola*	a moss				S2	3 Sensitive	1	42.6 ± 1.0	NB
N	*Seligeria calcarea*	Chalk Brittle Moss				S2	3 Sensitive	1	80.2 ± 0.0	NB
N	*Sphagnum lindbergii*	Lindberg's Peat Moss				S2	3 Sensitive	1	60.0 ± 0.0	NB
N	*Sphagnum flexuosum*	Flexuous Peatmoss				S2	3 Sensitive	1	54.2 ± 1.0	NB
N	*Tayloria serrata*	Serrate Trumpet Moss				S2	3 Sensitive	1	51.7 ± 0.0	NB
N	*Tortula mucronifolia*	Mucronate Screw Moss				S2	3 Sensitive	3	37.9 ± 0.0	NB

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N	*Anomobryum filiforme*	a moss				S2	5 Undetermined	1	44.7 ± 1.0	NB
N	*Fuscopannaria leucosticta*	Rimmed Shingles Lichen				S2	2 May Be At Risk	73	8.4 ± 0.0	NB
N	*Nephroma laevigatum*	Mustard Kidney Lichen				S2	2 May Be At Risk	2	33.6 ± 0.0	NB
N	*Peltigera lepidophora*	Scaly Pelt Lichen				S2	5 Undetermined	1	77.9 ± 0.0	NB
N	*Barbilophozia lycopodioides*	Greater Pawwort				S2?	6 Not Assessed	3	51.3 ± 1.0	NB
N	*Anacamptodon splachnoides*	a Moss				S2?	3 Sensitive	1	52.0 ± 0.0	NB
N	*Hygrohypnum montanum*	a Moss				S2?	3 Sensitive	2	49.9 ± 0.0	NB
N	*Schistostega pennata*	Luminous Moss				S2?	3 Sensitive	1	99.9 ± 1.0	NB
N	*Seligeria campylopoda*	a Moss				S2?	3 Sensitive	1	72.9 ± 1.0	NB
N	*Seligeria diversifolia*	a Moss				S2?	3 Sensitive	2	80.1 ± 1.0	NB
N	*Trichodon cylindricus*	Cylindric Hairy-teeth Moss				S2?	3 Sensitive	3	49.4 ± 0.0	NB
N	*Plagiomnium rostratum*	Long-beaked Leafy Moss				S2?	3 Sensitive	3	49.3 ± 0.0	NB
N	*Bryum uliginosum*	a Moss				S2S3	3 Sensitive	2	48.1 ± 9.0	NB
N	*Bryum weigelii*	Weigel's Bryum Moss				S2S3	3 Sensitive	1	80.1 ± 3.0	NB
N	*Campylium polygamum*	a Moss				S2S3	3 Sensitive	2	50.9 ± 0.0	NB
N	*Orthotrichum speciosum*	Showy Bristle Moss				S2S3	5 Undetermined	3	36.4 ± 0.0	NB
N	*Pohlia proligera*	Cottony Nodding Moss				S2S3	3 Sensitive	1	71.8 ± 2.0	NB
N	*Saelania glaucescens*	Blue Dew Moss				S2S3	3 Sensitive	4	17.4 ± 0.0	NB
N	*Scorpidium scorpioides*	Hooked Scorpion Moss				S2S3	3 Sensitive	3	15.9 ± 1.0	NB
N	*Sphagnum subfulvum*	a Peatmoss				S2S3	2 May Be At Risk	1	50.9 ± 0.0	NB
N	*Plagiomnium drummondii*	Drummond's Leafy Moss				S2S3	3 Sensitive	1	69.3 ± 8.0	NB
N	*Cyrtomnium hymenophylloides*	Short-pointed Lantern Moss				S2S3	3 Sensitive	3	36.8 ± 0.0	NB
N	*Tortella fragilis*	Fragile Twisted Moss				S3	3 Sensitive	1	79.3 ± 0.0	NB
N	*Hymenostylium recurvirostre*	Hymenostylium Moss				S3	3 Sensitive	2	79.0 ± 0.0	NB
N	*Collema nigrescens*	Blistered Tarpaper Lichen				S3	3 Sensitive	1	36.4 ± 0.0	NB
N	*Solorina saccata*	Woodland Owl Lichen				S3	5 Undetermined	10	17.5 ± 0.0	NB
N	*Leptogium lichenoides*	Tattered Jellyskin Lichen				S3	5 Undetermined	4	17.3 ± 0.0	NB
N	*Leptogium laceroides*	Short-bearded Jellyskin Lichen				S3	3 Sensitive	1	77.7 ± 0.0	NB
N	*Peltigera membranacea*	Membranous Pelt Lichen				S3	5 Undetermined	1	31.0 ± 0.0	NB
N	*Bryum amblyodon*	a Moss				S3?	4 Secure	1	79.3 ± 0.0	NB
N	*Anomodon rugelii*	Rugel's Anomodon Moss				S3S4	3 Sensitive	1	47.6 ± 8.0	NB
N	*Dicranella varia*	a Moss				S3S4	4 Secure	2	48.1 ± 9.0	NB
N	*Encalypta ciliata*	Fringed Extinquisher Moss				S3S4	3 Sensitive	1	18.7 ± 0.0	NB
N	*Fissidens bryoides*	Lesser Pocket Moss				S3S4	4 Secure	5	33.9 ± 0.0	NB
N	*Helodium blandowii*	Wetland-plume Moss				S3S4	4 Secure	1	79.2 ± 0.0	NB
N	*Heterocladium dimorphum*	Dimorphous Tangle Moss				S3S4	4 Secure	3	37.1 ± 1.0	NB
N	*Isopterygiopsis muelleriana*	a Moss				S3S4	4 Secure	6	17.4 ± 0.0	NB
N	*Myurella julacea*	Small Mouse-tail Moss				S3S4	4 Secure	5	18.7 ± 0.0	NB
N	*Splachnum rubrum*	Red Collar Moss				S3S4	4 Secure	1	80.2 ± 2.0	NB
N	*Weissia controversa*	Green-Cushioned Weissia				S3S4	4 Secure	1	79.0 ± 0.0	NB
N	*Abietinella abietina*	Wiry Fern Moss				S3S4	4 Secure	4	17.3 ± 0.0	NB
N	*Trichostomum tenuirostre*	Acid-Soil Moss				S3S4	4 Secure	2	71.9 ± 2.0	NB
N	*Pannaria rubiginosa*	Brown-eyed Shingle Lichen				S3S4	3 Sensitive	1	77.7 ± 0.0	NB
N	*Leptogium*	Beaded Jellyskin Lichen				S3S4	5 Undetermined	2	36.3 ± 0.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
	teretiusculum									
N	*Vahliella leucophaea*	Shelter Shingle Lichen				S3S4	5 Undetermined	4	17.4 ± 0.0	NB
N	*Nephroma parile*	Powdery Kidney Lichen				S3S4	4 Secure	2	17.1 ± 0.0	NB
N	*Protopannaria pezizoides*	Brown-gray Moss-shingle Lichen				S3S4	4 Secure	8	17.2 ± 0.0	NB
N	*Pseudocyphellaria perpetua*	Gilded Specklebelly Lichen				S3S4	3 Sensitive	2	77.7 ± 0.0	NB
N	*Fuscopannaria sorediata*	a Lichen				S3S4	5 Undetermined	1	77.8 ± 0.0	NB
N	*Stereocaulon paschale*	Easter Foam Lichen				S3S4	5 Undetermined	1	35.0 ± 1.0	NB
N	*Pannaria conoplea*	Mealy-rimmed Shingle Lichen				S3S4	3 Sensitive	3	50.8 ± 0.0	NB
N	*Hennediella heimii*	Long-Stalked Beardless Moss				SH	2 May Be At Risk	1	55.8 ± 10.0	NB
P	*Symphyotrichum anticostense*	Anticosti Aster	Threatened	Threatened	Endangered	S2S3	1 At Risk	350	58.9 ± 0.0	NB
P	*Symphyotrichum subulatum (Bathurst pop)*	Bathurst Aster - Bathurst pop.	Special Concern	Special Concern	Endangered	S2	1 At Risk	212	44.8 ± 0.0	NB
P	*Isoetes prototypus*	Prototype Quillwort	Special Concern	Special Concern	Endangered	S2	1 At Risk	1	97.3 ± 0.0	NB
P	*Eriocaulon parkeri*	Parker's Pipewort	Not At Risk		Endangered	S2	1 At Risk	82	75.4 ± 0.0	NB
P	*Pterospora andromedea*	Woodland Pinedrops			Endangered	S1	1 At Risk	21	26.3 ± 0.0	NB
P	*Arnica lonchophylla*	Northern Arnica				S1	2 May Be At Risk	5	39.1 ± 0.0	NB
P	*Bidens eatonii*	Eaton's Beggarticks				S1	2 May Be At Risk	7	79.4 ± 0.0	NB
P	*Erigeron acris ssp. politus*	Bitter Fleabane				S1	2 May Be At Risk	1	60.6 ± 100.0	NB
P	*Hieracium robinsonii*	Robinson's Hawkweed				S1	3 Sensitive	1	96.6 ± 0.0	NB
P	*Symphyotrichum laeve*	Smooth Aster				S1	5 Undetermined	2	81.8 ± 1.0	NB
P	*Canadanthus modestus*	Great Northern Aster				S1	2 May Be At Risk	15	82.2 ± 0.0	NB
P	*Betula glandulosa*	Glandular Birch				S1	2 May Be At Risk	13	22.3 ± 0.0	NB
P	*Cynoglossum virginianum var. boreale*	Wild Comfrey				S1	2 May Be At Risk	5	20.6 ± 0.0	NB
P	*Hackelia deflexa var. americana*	Nodding Stickseed				S1	2 May Be At Risk	4	47.7 ± 10.0	NB
P	*Arabis x divaricarpa*	Limestone Rockcress				S1	2 May Be At Risk	14	50.8 ± 5.0	NB
P	*Cardamine parviflora var. arenicola*	Small-flowered Bittercress				S1	2 May Be At Risk	1	40.6 ± 0.0	NB
P	*Descurainia incana ssp. incana*	Gray Tansy Mustard				S1	2 May Be At Risk	4	58.0 ± 0.0	NB
P	*Draba arabisans*	Rock Whitlow-Grass				S1	2 May Be At Risk	2	79.3 ± 0.0	NB
P	*Draba breweri var. cana*	Brewer's Whitlow-grass				S1	2 May Be At Risk	1	82.1 ± 1.0	NB
P	*Draba glabella*	Rock Whitlow-Grass				S1	2 May Be At Risk	8	50.8 ± 0.0	NB
P	*Draba incana*	Twisted Whitlow-grass				S1	2 May Be At Risk	2	90.6 ± 0.0	NB
P	*Stellaria crassifolia*	Fleshy Stitchwort				S1	2 May Be At Risk	1	51.6 ± 5.0	NB
P	*Stellaria longipes*	Long-stalked Starwort				S1	2 May Be At Risk	9	49.2 ± 5.0	NB
P	*Chenopodium capitatum*	Strawberry-blite				S1	2 May Be At Risk	1	50.4 ± 1.0	NB
P	*Chenopodium simplex*	Maple-leaved Goosefoot				S1	2 May Be At Risk	1	84.4 ± 0.0	NB
P	*Drosera anglica*	English Sundew				S1	2 May Be At Risk	1	78.4 ± 0.0	NB
P	*Vaccinium boreale*	Northern Blueberry				S1	2 May Be At Risk	12	22.3 ± 0.0	NB
P	*Vaccinium uliginosum*	Alpine Bilberry				S1	2 May Be At Risk	5	22.3 ± 0.0	NB
P	*Desmodium glutinosum*	Large Tick-Trefoil				S1	2 May Be At Risk	1	73.6 ± 0.0	NB
P	*Pinguicula vulgaris*	Common Butterwort				S1	3 Sensitive	29	61.5 ± 0.0	NB
P	*Polygonum viviparum*	Alpine Bistort				S1	2 May Be At Risk	1	54.6 ± 0.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
P	*Ranunculus lapponicus*	Lapland Buttercup				S1	2 May Be At Risk	1	46.5 ± 0.0	NB
P	*Ranunculus sceleratus*	Cursed Buttercup				S1	2 May Be At Risk	9	43.6 ± 0.0	NB
P	*Amelanchier fernaldii*	Fernald's Serviceberry				S1	2 May Be At Risk	1	46.6 ± 0.0	NB
P	*Salix serissima*	Autumn Willow				S1	2 May Be At Risk	4	46.8 ± 0.0	NB
P	*Agalinis paupercula var. borealis*	Small-flowered Agalinis				S1	2 May Be At Risk	9	90.1 ± 0.0	NB
P	*Limosella aquatica*	Water Mudwort				S1	2 May Be At Risk	18	57.6 ± 0.0	NB
P	*Carex backii*	Rocky Mountain Sedge				S1	2 May Be At Risk	2	53.8 ± 0.0	NB
P	*Carex bigelowii*	Bigelow's Sedge				S1	2 May Be At Risk	7	42.4 ± 0.0	NB
P	*Carex cephaloidea*	Thin-leaved Sedge				S1	2 May Be At Risk	2	59.3 ± 1.0	NB
P	*Carex glareosa var. amphigena*	Gravel Sedge				S1	2 May Be At Risk	2	56.1 ± 5.0	NB
P	*Carex norvegica ssp. inferalpina*	Scandinavian Sedge				S1	2 May Be At Risk	3	73.6 ± 50.0	NB
P	*Carex saxatilis*	Russet Sedge				S1	2 May Be At Risk	6	65.0 ± 0.0	NB
P	*Carex viridula var. elatior*	Greenish Sedge				S1	2 May Be At Risk	14	46.7 ± 0.0	NB
P	*Cyperus diandrus*	Low Flatsedge				S1	2 May Be At Risk	2	80.2 ± 1.0	NB
P	*Cyperus bipartitus*	Shining Flatsedge				S1	2 May Be At Risk	14	58.6 ± 1.0	NB
P	*Schoenoplectus smithii*	Smith's Bulrush				S1	2 May Be At Risk	18	76.5 ± 0.0	NB
P	*Juncus greenei*	Greene's Rush				S1	2 May Be At Risk	1	85.1 ± 1.0	NB
P	*Juncus subtilis*	Creeping Rush				S1	2 May Be At Risk	8	57.7 ± 0.0	NB
P	*Juncus trifidus*	Highland Rush				S1	2 May Be At Risk	5	42.5 ± 0.0	NB
P	*Allium canadense*	Canada Garlic				S1	2 May Be At Risk	1	90.2 ± 1.0	NB
P	*Zigadenus elegans ssp. glaucus*	Mountain Death Camas				S1	2 May Be At Risk	10	47.9 ± 0.0	NB
P	*Malaxis brachypoda*	White Adder's-Mouth				S1	2 May Be At Risk	2	48.5 ± 0.0	NB
P	*Platanthera flava var. herbiola*	Pale Green Orchid				S1	2 May Be At Risk	1	62.9 ± 0.0	NB
P	*Catabrosa aquatica var. laurentiana*	Water Whorl Grass				S1	2 May Be At Risk	2	53.6 ± 5.0	NB
P	*Dichanthelium xanthophysum*	Slender Panic Grass				S1	2 May Be At Risk	3	46.8 ± 0.0	NB
P	*Elymus hystrix var. bigeloviana*	Spreading Wild Rye				S1	2 May Be At Risk	2	53.6 ± 0.0	NB
P	*Festuca subverticillata*	Nodding Fescue				S1	2 May Be At Risk	4	73.0 ± 0.0	NB
P	*Puccinellia ambigua*	Dwarf Alkali Grass				S1	5 Undetermined	1	89.8 ± 0.0	NB
P	*Zizania aquatica var. brevis*	Indian Wild Rice				S1	2 May Be At Risk	16	79.6 ± 0.0	NB
P	*Stuckenia filiformis ssp. occidentalis*	Thread-leaved Pondweed				S1	2 May Be At Risk	1	58.9 ± 1.0	NB
P	*Potamogeton friesii*	Fries' Pondweed				S1	2 May Be At Risk	8	51.7 ± 0.0	NB
P	*Potamogeton nodosus*	Long-leaved Pondweed				S1	2 May Be At Risk	1	91.0 ± 0.0	NB
P	*Cystopteris laurentiana*	Laurentian Bladder Fern				S1	2 May Be At Risk	1	35.6 ± 0.0	NB
P	*Dryopteris filix-mas*	Male Fern				S1	2 May Be At Risk	2	59.9 ± 0.0	NB
P	*Gymnocarpium robertianum*	Limestone Oak Fern				S1	2 May Be At Risk	14	42.1 ± 0.0	NB
P	*Huperzia selago*	Northern Firmoss				S1	2 May Be At Risk	4	42.5 ± 0.0	NB
P	*Cuscuta campestris*	Field Dodder				S1?	2 May Be At Risk	3	90.4 ± 0.0	NB
P	*Galium trifidum ssp. subbiflorum*	Three-petaled Bedstraw				S1?	5 Undetermined	2	42.5 ± 0.0	NB
P	*Carex laxiflora*	Loose-Flowered Sedge				S1?	5 Undetermined	1	27.9 ± 2.0	NB
P	*Rumex aquaticus var. fenestratus*	Western Dock				S1S2	2 May Be At Risk	14	21.3 ± 0.0	NB
P	*Anemone multifida var. richardsiana*	Cut-leaved Anemone				S1S2	5 Undetermined	3	75.2 ± 0.0	NB

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P	*Carex crawei*	Crawe's Sedge				S1S2	2 May Be At Risk	23	62.8 ± 0.0	NB
P	*Thelypteris simulata*	Bog Fern				S1S2	2 May Be At Risk	1	97.6 ± 1.0	NB
P	*Cuscuta cephalanthi*	Buttonbush Dodder				S1S3	2 May Be At Risk	23	43.7 ± 0.0	NB
P	*Scirpus atrovirens*	Dark-green Bulrush				S1S3	5 Undetermined	32	56.5 ± 0.0	NB
P	*Osmorhiza depauperata*	Blunt Sweet Cicely				S2	3 Sensitive	7	33.1 ± 0.0	NB
P	*Osmorhiza longistylis*	Smooth Sweet Cicely				S2	3 Sensitive	3	56.8 ± 5.0	NB
P	*Solidago simplex var. racemosa*	Sticky Goldenrod				S2	2 May Be At Risk	3	75.8 ± 0.0	NB
P	*Ionactis linariifolius*	Stiff Aster				S2	3 Sensitive	42	44.3 ± 0.0	NB
P	*Symphyotrichum subulatum*	Annual Saltmarsh Aster				S2	1 At Risk	76	54.3 ± 0.0	NB
P	*Impatiens pallida*	Pale Jewelweed				S2	2 May Be At Risk	6	66.1 ± 1.0	NB
P	*Betula minor*	Dwarf White Birch				S2	3 Sensitive	13	41.3 ± 0.0	NB
P	*Arabis drummondii*	Drummond's Rockcress				S2	3 Sensitive	5	35.6 ± 0.0	NB
P	*Sagina nodosa*	Knotted Pearlwort				S2	3 Sensitive	4	46.6 ± 0.0	NB
P	*Stellaria longifolia*	Long-leaved Starwort				S2	3 Sensitive	1	40.3 ± 0.0	NB
P	*Atriplex franktonii*	Frankton's Saltbush				S2	4 Secure	2	47.6 ± 0.0	NB
P	*Chenopodium rubrum*	Red Pigweed				S2	3 Sensitive	4	51.6 ± 0.0	NB
P	*Hypericum dissimulatum*	Disguised St John's-wort				S2	3 Sensitive	1	46.6 ± 1.0	NB
P	*Shepherdia canadensis*	Soapberry				S2	3 Sensitive	25	49.4 ± 1.0	NB
P	*Astragalus eucosmus*	Elegant Milk-vetch				S2	2 May Be At Risk	14	39.1 ± 0.0	NB
P	*Oxytropis campestris var. johannensis*	Field Locoweed				S2	3 Sensitive	38	46.7 ± 10.0	NB
P	*Gentiana linearis*	Narrow-Leaved Gentian				S2	3 Sensitive	11	44.0 ± 0.0	NB
P	*Myriophyllum humile*	Low Water Milfoil				S2	3 Sensitive	1	62.7 ± 1.0	NB
P	*Nuphar lutea ssp. rubrodisca*	Red-disked Yellow Pond-lily				S2	3 Sensitive	4	21.6 ± 0.0	NB
P	*Orobanche uniflora*	One-Flowered Broomrape				S2	3 Sensitive	2	85.9 ± 10.0	NB
P	*Polygala senega*	Seneca Snakeroot				S2	3 Sensitive	7	73.7 ± 0.0	NB
P	*Polygonum amphibium var. emersum*	Water Smartweed				S2	3 Sensitive	1	91.0 ± 0.0	NB
P	*Podostemum ceratophyllum*	Horn-leaved Riverweed				S2	3 Sensitive	8	84.2 ± 0.0	NB
P	*Anemone multifida*	Cut-leaved Anemone				S2	3 Sensitive	33	56.6 ± 10.0	NB
P	*Anemone parviflora*	Small-flowered Anemone				S2	3 Sensitive	24	69.8 ± 5.0	NB
P	*Hepatica nobilis var. obtusa*	Round-lobed Hepatica				S2	3 Sensitive	4	33.0 ± 0.0	NB
P	*Ranunculus longirostris*	Eastern White Water-Crowfoot				S2	5 Undetermined	4	10.7 ± 1.0	NB
P	*Crataegus scabrida*	Rough Hawthorn				S2	3 Sensitive	2	46.7 ± 1.0	NB
P	*Rosa acicularis ssp. sayi*	Prickly Rose				S2	2 May Be At Risk	102	26.1 ± 0.0	NB
P	*Galium kamtschaticum*	Northern Wild Licorice				S2	3 Sensitive	8	47.1 ± 1.0	NB
P	*Salix candida*	Sage Willow				S2	3 Sensitive	20	46.7 ± 0.0	NB
P	*Castilleja septentrionalis*	Northeastern Paintbrush				S2	3 Sensitive	25	38.4 ± 1.0	NB
P	*Viola novae-angliae*	New England Violet				S2	3 Sensitive	5	96.6 ± 0.0	NB
P	*Sagittaria calycina var. spongiosa*	Long-lobed Arrowhead				S2	4 Secure	56	75.7 ± 0.0	NB
P	*Carex concinna*	Beautiful Sedge				S2	3 Sensitive	37	50.8 ± 0.0	NB
P	*Carex granularis*	Limestone Meadow Sedge				S2	3 Sensitive	54	49.1 ± 5.0	NB
P	*Carex gynocrates*	Northern Bog Sedge				S2	3 Sensitive	15	46.5 ± 0.0	NB
P	*Carex hirtifolia*	Pubescent Sedge				S2	3 Sensitive	13	62.7 ± 0.0	NB
P	*Carex livida var.*	Livid Sedge				S2	3 Sensitive	2	59.9 ± 0.0	NB

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	radicaulis									
P	*Carex prairea*	Prairie Sedge				S2	3 Sensitive	3	46.9 ± 1.0	NB
P	*Carex rostrata*	Narrow-leaved Beaked Sedge				S2	3 Sensitive	7	20.8 ± 0.0	NB
P	*Carex salina*	Saltmarsh Sedge				S2	3 Sensitive	5	50.2 ± 5.0	NB
P	*Carex sprengelii*	Longbeak Sedge				S2	3 Sensitive	6	46.3 ± 0.0	NB
P	*Carex tenuiflora*	Sparse-Flowered Sedge				S2	2 May Be At Risk	1	49.0 ± 1.0	NB
P	*Eriophorum gracile*	Slender Cottongrass				S2	2 May Be At Risk	1	46.4 ± 0.0	NB
P	*Blysmus rufus*	Red Bulrush				S2	3 Sensitive	37	46.8 ± 0.0	NB
P	*Elodea nuttallii*	Nuttall's Waterweed				S2	3 Sensitive	5	52.6 ± 0.0	NB
P	*Juncus vaseyi*	Vasey Rush				S2	3 Sensitive	29	33.8 ± 0.0	NB
P	*Allium tricoccum*	Wild Leek				S2	2 May Be At Risk	52	59.2 ± 5.0	NB
P	*Amerorchis rotundifolia*	Small Round-leaved Orchis				S2	2 May Be At Risk	14	45.1 ± 0.0	NB
P	*Calypso bulbosa var. americana*	Calypso				S2	2 May Be At Risk	8	18.4 ± 5.0	NB
P	*Coeloglossum viride var. virescens*	Long-bracted Frog Orchid				S2	2 May Be At Risk	8	38.3 ± 1.0	NB
P	*Cypripedium parviflorum var. makasin*	Small Yellow Lady's-Slipper				S2	2 May Be At Risk	4	41.7 ± 0.0	NB
P	*Goodyera oblongifolia*	Menzies' Rattlesnake-plantain				S2	3 Sensitive	30	12.2 ± 10.0	NB
P	*Spiranthes lucida*	Shining Ladies'-Tresses				S2	3 Sensitive	5	85.7 ± 0.0	NB
P	*Agrostis mertensii*	Northern Bent Grass				S2	2 May Be At Risk	58	21.4 ± 0.0	NB
P	*Dichanthelium linearifolium*	Narrow-leaved Panic Grass				S2	3 Sensitive	3	43.0 ± 0.0	NB
P	*Piptatherum canadense*	Canada Rice Grass				S2	3 Sensitive	3	41.3 ± 0.0	NB
P	*Poa glauca*	Glaucous Blue Grass				S2	4 Secure	20	35.6 ± 0.0	NB
P	*Zizania aquatica var. aquatica*	Indian Wild Rice				S2	5 Undetermined	6	79.6 ± 0.0	NB
P	*Piptatherum pungens*	Slender Rice Grass				S2	2 May Be At Risk	9	42.5 ± 0.0	NB
P	*Asplenium trichomanes*	Maidenhair Spleenwort				S2	3 Sensitive	4	54.8 ± 0.0	NB
P	*Woodsia alpina*	Alpine Cliff Fern				S2	3 Sensitive	39	39.1 ± 0.0	NB
P	*Lycopodium sitchense*	Sitka Clubmoss				S2	3 Sensitive	4	42.3 ± 0.0	NB
P	*Botrychium minganense*	Mingan Moonwort				S2	3 Sensitive	12	47.2 ± 1.0	NB
P	*Selaginella selaginoides*	Low Spikemoss				S2	3 Sensitive	30	41.8 ± 0.0	NB
P	*Symphyotrichum novi-belgii var. crenifolium*	New York Aster				S2?	5 Undetermined	1	79.9 ± 1.0	NB
P	*Humulus lupulus var. lupuloides*	Common Hop				S2?	3 Sensitive	3	48.0 ± 1.0	NB
P	*Crataegus macrosperma*	Big-Fruit Hawthorn				S2?	5 Undetermined	1	46.8 ± 0.0	NB
P	*Galium obtusum*	Blunt-leaved Bedstraw				S2?	4 Secure	4	24.9 ± 0.0	NB
P	*Salix myricoides*	Bayberry Willow				S2?	3 Sensitive	15	50.7 ± 0.0	NB
P	*Carex vacillans*	Estuarine Sedge				S2?	3 Sensitive	4	58.8 ± 0.0	NB
P	*Platanthera huronensis*	Fragrant Green Orchid				S2?	5 Undetermined	4	47.6 ± 0.0	NB
P	*Solidago altissima*	Tall Goldenrod				S2S3	4 Secure	74	49.6 ± 0.0	NB
P	*Barbarea orthoceras*	American Yellow Rocket				S2S3	3 Sensitive	13	48.1 ± 1.0	NB
P	*Ceratophyllum echinatum*	Prickly Hornwort				S2S3	3 Sensitive	1	80.2 ± 0.0	NB
P	*Callitriche hermaphroditica*	Northern Water-starwort				S2S3	4 Secure	22	51.6 ± 0.0	NB
P	*Lonicera oblongifolia*	Swamp Fly Honeysuckle				S2S3	3 Sensitive	2	89.7 ± 0.0	NB
P	*Elatine americana*	American Waterwort				S2S3	3 Sensitive	15	79.5 ± 0.0	NB
P	*Epilobium coloratum*	Purple-veined Willowherb				S2S3	3 Sensitive	1	47.7 ± 0.0	NB

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P	*Rumex pallidus*	Seabeach Dock				S2S3	3 Sensitive	6	47.8 ± 17.0	NB
P	*Amelanchier sanguinea var. gaspensis*	Round-Leaved Serviceberry				S2S3	5 Undetermined	4	49.3 ± 0.0	NB
P	*Rubus pensilvanicus*	Pennsylvania Blackberry				S2S3	4 Secure	1	89.7 ± 2.0	NB
P	*Galium labradoricum*	Labrador Bedstraw				S2S3	3 Sensitive	11	46.5 ± 0.0	NB
P	*Valeriana uliginosa*	Swamp Valerian				S2S3	3 Sensitive	13	45.1 ± 0.0	NB
P	*Carex adusta*	Lesser Brown Sedge				S2S3	4 Secure	6	38.2 ± 0.0	NB
P	*Juncus brachycephalus*	Small-Head Rush				S2S3	3 Sensitive	8	46.8 ± 0.0	NB
P	*Corallorhiza maculata var. occidentalis*	Spotted Coralroot				S2S3	3 Sensitive	2	55.5 ± 1.0	NB
P	*Corallorhiza maculata var. maculata*	Spotted Coralroot				S2S3	3 Sensitive	8	45.8 ± 1.0	NB
P	*Listera auriculata*	Auricled Twayblade				S2S3	3 Sensitive	14	14.1 ± 0.0	NB
P	*Spiranthes cernua*	Nodding Ladies'-Tresses				S2S3	3 Sensitive	1	94.6 ± 0.0	NB
P	*Stuckenia filiformis*	Thread-leaved Pondweed				S2S3	3 Sensitive	1	58.6 ± 0.0	NB
P	*Stuckenia filiformis ssp. alpina*	Thread-leaved Pondweed				S2S3	3 Sensitive	11	52.7 ± 0.0	NB
P	*Potamogeton praelongus*	White-stemmed Pondweed				S2S3	4 Secure	5	42.0 ± 5.0	NB
P	*Isoetes acadiensis*	Acadian Quillwort				S2S3	3 Sensitive	1	79.2 ± 0.0	NB
P	*Panax trifolius*	Dwarf Ginseng				S3	3 Sensitive	7	50.7 ± 0.0	NB
P	*Arnica lanceolata*	Lance-leaved Arnica				S3	4 Secure	69	28.6 ± 0.0	NB
P	*Artemisia campestris ssp. caudata*	Field Wormwood				S3	4 Secure	3	48.3 ± 0.0	NB
P	*Bidens hyperborea*	Estuary Beggarticks				S3	4 Secure	80	44.0 ± 1.0	NB
P	*Bidens hyperborea var. hyperborea*	Estuary Beggarticks				S3	4 Secure	19	44.2 ± 1.0	NB
P	*Erigeron hyssopifolius*	Hyssop-leaved Fleabane				S3	4 Secure	141	22.1 ± 1.0	NB
P	*Prenanthes racemosa*	Glaucous Rattlesnakeroot				S3	4 Secure	14	58.7 ± 0.0	NB
P	*Tanacetum bipinnatum ssp. huronense*	Lake Huron Tansy				S3	4 Secure	15	71.9 ± 0.0	NB
P	*Symphyotrichum boreale*	Boreal Aster				S3	3 Sensitive	6	47.3 ± 5.0	NB
P	*Betula pumila*	Bog Birch				S3	4 Secure	6	46.8 ± 0.0	NB
P	*Arabis glabra*	Tower Mustard				S3	5 Undetermined	14	30.0 ± 0.0	NB
P	*Arabis hirsuta var. pycnocarpa*	Western Hairy Rockcress				S3	4 Secure	15	44.8 ± 0.0	NB
P	*Cardamine maxima*	Large Toothwort				S3	4 Secure	1	66.1 ± 0.0	NB
P	*Subularia aquatica var. americana*	Water Awlwort				S3	4 Secure	1	62.6 ± 1.0	NB
P	*Stellaria humifusa*	Saltmarsh Starwort				S3	4 Secure	8	44.2 ± 0.0	NB
P	*Hudsonia tomentosa*	Woolly Beach-heath				S3	4 Secure	20	42.5 ± 0.0	NB
P	*Crassula aquatica*	Water Pygmyweed				S3	4 Secure	44	75.6 ± 1.0	NB
P	*Penthorum sedoides*	Ditch Stonecrop				S3	4 Secure	5	57.6 ± 0.0	NB
P	*Elatine minima*	Small Waterwort				S3	4 Secure	6	35.0 ± 1.0	NB
P	*Astragalus alpinus*	Alpine Milk-vetch				S3	4 Secure	4	65.3 ± 0.0	NB
P	*Astragalus alpinus var. brunetianus*	Alpine Milk-Vetch				S3	4 Secure	71	59.6 ± 1.0	NB
P	*Hedysarum alpinum*	Alpine Sweet-vetch				S3	4 Secure	206	46.7 ± 0.0	NB
P	*Gentianella amarella ssp. acuta*	Northern Gentian				S3	4 Secure	11	42.4 ± 5.0	NB
P	*Geranium bicknellii*	Bicknell's Crane's-bill				S3	4 Secure	7	20.8 ± 1.0	NB
P	*Myriophyllum farwellii*	Farwell's Water Milfoil				S3	4 Secure	3	67.6 ± 0.0	NB
P	*Myriophyllum verticillatum*	Whorled Water Milfoil				S3	4 Secure	5	61.9 ± 0.0	NB

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P	*Teucrium canadense*	Canada Germander				S3	3 Sensitive	1	84.3 ± 5.0	NB
P	*Nuphar lutea ssp. pumila*	Small Yellow Pond-lily				S3	4 Secure	8	2.1 ± 1.0	NB
P	*Epilobium hornemannii*	Hornemann's Willowherb				S3	4 Secure	33	30.3 ± 0.0	NB
P	*Epilobium strictum*	Downy Willowherb				S3	4 Secure	2	73.8 ± 0.0	NB
P	*Polygonum punctatum*	Dotted Smartweed				S3	4 Secure	1	52.1 ± 0.0	NB
P	*Polygonum punctatum var. confertiflorum*	Dotted Smartweed				S3	4 Secure	26	75.2 ± 0.0	NB
P	*Polygonum scandens*	Climbing False Buckwheat				S3	4 Secure	3	59.4 ± 1.0	NB
P	*Littorella uniflora*	American Shoreweed				S3	4 Secure	2	18.6 ± 1.0	NB
P	*Primula mistassinica*	Mistassini Primrose				S3	4 Secure	26	33.0 ± 10.0	NB
P	*Samolus valerandi ssp. parviflorus*	Seaside Brookweed				S3	4 Secure	42	80.0 ± 0.0	NB
P	*Pyrola minor*	Lesser Pyrola				S3	4 Secure	21	19.9 ± 1.0	NB
P	*Clematis occidentalis*	Purple Clematis				S3	4 Secure	11	26.9 ± 1.0	NB
P	*Ranunculus gmelinii*	Gmelin's Water Buttercup				S3	4 Secure	11	46.5 ± 0.0	NB
P	*Thalictrum venulosum*	Northern Meadow-rue				S3	4 Secure	4	44.5 ± 0.0	NB
P	*Rosa palustris*	Swamp Rose				S3	4 Secure	1	85.3 ± 1.0	NB
P	*Sanguisorba canadensis*	Canada Burnet				S3	4 Secure	48	45.1 ± 0.0	NB
P	*Galium boreale*	Northern Bedstraw				S3	4 Secure	6	45.2 ± 1.0	NB
P	*Salix interior*	Sandbar Willow				S3	4 Secure	21	61.5 ± 0.0	NB
P	*Salix pedicellaris*	Bog Willow				S3	4 Secure	3	50.6 ± 0.0	NB
P	*Comandra umbellata*	Bastard's Toadflax				S3	4 Secure	8	47.7 ± 0.0	NB
P	*Parnassia glauca*	Fen Grass-of-Parnassus				S3	4 Secure	202	39.0 ± 0.0	NB
P	*Limosella australis*	Southern Mudwort				S3	4 Secure	54	46.9 ± 0.0	NB
P	*Veronica serpyllifolia ssp. humifusa*	Thyme-Leaved Speedwell				S3	4 Secure	14	20.9 ± 0.0	NB
P	*Boehmeria cylindrica*	Small-spike False-nettle				S3	3 Sensitive	7	74.9 ± 0.0	NB
P	*Pilea pumila*	Dwarf Clearweed				S3	4 Secure	6	75.9 ± 0.0	NB
P	*Viola adunca*	Hooked Violet				S3	4 Secure	11	49.0 ± 0.0	NB
P	*Viola nephrophylla*	Northern Bog Violet				S3	4 Secure	121	46.8 ± 0.0	NB
P	*Carex arcta*	Northern Clustered Sedge				S3	4 Secure	8	39.1 ± 0.0	NB
P	*Carex atratiformis*	Scabrous Black Sedge				S3	4 Secure	47	25.9 ± 0.0	NB
P	*Carex capillaris*	Hairlike Sedge				S3	4 Secure	96	28.2 ± 0.0	NB
P	*Carex conoidea*	Field Sedge				S3	4 Secure	4	55.2 ± 10.0	NB
P	*Carex eburnea*	Bristle-leaved Sedge				S3	4 Secure	98	33.3 ± 0.0	NB
P	*Carex exilis*	Coastal Sedge				S3	4 Secure	2	78.3 ± 0.0	NB
P	*Carex garberi*	Garber's Sedge				S3	3 Sensitive	44	26.3 ± 0.0	NB
P	*Carex haydenii*	Hayden's Sedge				S3	4 Secure	3	24.9 ± 0.0	NB
P	*Carex michauxiana*	Michaux's Sedge				S3	4 Secure	7	62.0 ± 1.0	NB
P	*Carex ormostachya*	Necklace Spike Sedge				S3	4 Secure	14	21.1 ± 0.0	NB
P	*Carex rosea*	Rosy Sedge				S3	4 Secure	1	41.9 ± 5.0	NB
P	*Carex tenera*	Tender Sedge				S3	4 Secure	2	90.6 ± 1.0	NB
P	*Carex tuckermanii*	Tuckerman's Sedge				S3	4 Secure	8	38.9 ± 0.0	NB
P	*Carex vaginata*	Sheathed Sedge				S3	3 Sensitive	29	45.1 ± 0.0	NB
P	*Carex wiegandii*	Wiegand's Sedge				S3	4 Secure	6	35.4 ± 0.0	NB
P	*Carex recta*	Estuary Sedge				S3	4 Secure	7	43.6 ± 0.0	NB
P	*Cyperus dentatus*	Toothed Flatsedge				S3	4 Secure	1	52.0 ± 10.0	NB
P	*Cyperus esculentus*	Perennial Yellow Nutsedge				S3	4 Secure	2	91.0 ± 0.0	NB
P	*Eleocharis intermedia*	Matted Spikerush				S3	4 Secure	53	44.8 ± 0.0	NB
P	*Eleocharis quinqueflora*	Few-flowered Spikerush				S3	4 Secure	45	61.5 ± 0.0	NB
P	*Rhynchospora capitellata*	Small-headed Beakrush				S3	4 Secure	58	32.9 ± 0.0	NB
P	*Rhynchospora fusca*	Brown Beakrush				S3	4 Secure	6	61.3 ± 1.0	NB
P	*Trichophorum clintonii*	Clinton's Clubrush				S3	4 Secure	67	30.4 ± 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	*Schoenoplectus torreyi*	Torrey's Bulrush				S3	4 Secure	7	75.6 ± 0.0	NB
P	*Triantha glutinosa*	Sticky False-Asphodel				S3	4 Secure	82	44.8 ± 50.0	NB
P	*Cypripedium reginae*	Showy Lady's-Slipper				S3	3 Sensitive	17	46.8 ± 0.0	NB
P	*Liparis loeselii*	Loesel's Twayblade				S3	4 Secure	4	40.9 ± 1.0	NB
P	*Platanthera blephariglottis*	White Fringed Orchid				S3	4 Secure	14	73.8 ± 0.0	NB
P	*Platanthera grandiflora*	Large Purple Fringed Orchid				S3	3 Sensitive	12	35.4 ± 0.0	NB
P	*Bromus latiglumis*	Broad-Glumed Brome				S3	3 Sensitive	48	27.2 ± 0.0	NB
P	*Dichanthelium depauperatum*	Starved Panic Grass				S3	4 Secure	13	43.0 ± 0.0	NB
P	*Muhlenbergia richardsonis*	Mat Muhly				S3	4 Secure	37	62.3 ± 0.0	NB
P	*Potamogeton obtusifolius*	Blunt-leaved Pondweed				S3	4 Secure	17	14.5 ± 0.0	NB
P	*Potamogeton richardsonii*	Richardson's Pondweed				S3	3 Sensitive	5	18.5 ± 1.0	NB
P	*Xyris montana*	Northern Yellow-Eyed-Grass				S3	4 Secure	1	96.3 ± 5.0	NB
P	*Zannichellia palustris*	Horned Pondweed				S3	4 Secure	35	43.9 ± 0.0	NB
P	*Adiantum pedatum*	Northern Maidenhair Fern				S3	4 Secure	10	61.5 ± 1.0	NB
P	*Cryptogramma stelleri*	Steller's Rockbrake				S3	4 Secure	48	29.6 ± 0.0	NB
P	*Asplenium trichomanes-ramosum*	Green Spleenwort				S3	4 Secure	42	33.3 ± 0.0	NB
P	*Dryopteris fragrans var. remotiuscula*	Fragrant Wood Fern				S3	4 Secure	48	21.9 ± 0.0	NB
P	*Dryopteris goldiana*	Goldie's Woodfern				S3	3 Sensitive	58	61.1 ± 0.0	NB
P	*Woodsia glabella*	Smooth Cliff Fern				S3	4 Secure	27	33.3 ± 0.0	NB
P	*Equisetum palustre*	Marsh Horsetail				S3	4 Secure	8	33.1 ± 0.0	NB
P	*Isoetes tuckermanii*	Tuckerman's Quillwort				S3	4 Secure	4	42.9 ± 1.0	NB
P	*Lycopodium sabinifolium*	Ground-Fir				S3	4 Secure	10	22.6 ± 0.0	NB
P	*Huperzia appalachiana*	Appalachian Fir-Clubmoss				S3	3 Sensitive	9	42.5 ± 0.0	NB
P	*Botrychium lanceolatum var. angustisegmentum*	Lance-Leaf Grape-Fern				S3	3 Sensitive	5	33.6 ± 0.0	NB
P	*Botrychium simplex*	Least Moonwort				S3	4 Secure	6	35.8 ± 0.0	NB
P	*Polypodium appalachianum*	Appalachian Polypody				S3	4 Secure	2	48.2 ± 1.0	NB
P	*Mertensia maritima*	Sea Lungwort				S3S4	4 Secure	8	47.4 ± 0.0	NB
P	*Lobelia kalmii*	Brook Lobelia				S3S4	4 Secure	138	35.6 ± 0.0	NB
P	*Suaeda calceoliformis*	Horned Sea-blite				S3S4	4 Secure	11	47.4 ± 0.0	NB
P	*Myriophyllum sibiricum*	Siberian Water Milfoil				S3S4	4 Secure	20	49.1 ± 0.0	NB
P	*Stachys pilosa*	Hairy Hedge-Nettle				S3S4	5 Undetermined	21	25.0 ± 1.0	NB
P	*Potentilla arguta*	Tall Cinquefoil				S3S4	4 Secure	44	33.1 ± 0.0	NB
P	*Rubus chamaemorus*	Cloudberry				S3S4	4 Secure	6	47.2 ± 0.0	NB
P	*Geocaulon lividum*	Northern Comandra				S3S4	4 Secure	30	13.7 ± 0.0	NB
P	*Juniperus horizontalis*	Creeping Juniper				S3S4	4 Secure	2	48.5 ± 1.0	NB
P	*Cladium mariscoides*	Smooth Twigrush				S3S4	4 Secure	2	61.1 ± 0.0	NB
P	*Eriophorum russeolum*	Russet Cottongrass				S3S4	4 Secure	4	47.1 ± 1.0	NB
P	*Triglochin gaspensis*	Gasp├ Arrowgrass				S3S4	4 Secure	37	44.8 ± 0.0	NB
P	*Corallorhiza maculata*	Spotted Coralroot				S3S4	3 Sensitive	16	30.4 ± 0.0	NB
P	*Calamagrostis stricta*	Slim-stemmed Reed Grass				S3S4	4 Secure	3	46.8 ± 0.0	NB
P	*Calamagrostis stricta ssp. stricta*	Slim-stemmed Reed Grass				S3S4	4 Secure	1	80.6 ± 0.0	NB
P	*Distichlis spicata*	Salt Grass				S3S4	4 Secure	6	47.6 ± 0.0	NB
P	*Potamogeton oakesianus*	Oakes' Pondweed				S3S4	4 Secure	7	36.2 ± 0.0	NB
P	*Polygonum raii*	Sharp-fruited Knotweed				SH	0.1 Extirpated	5	50.2 ± 10.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
P	*Montia fontana*	Water Blinks				SH	2 May Be At Risk	2	60.6 ± 100.0	NB
P	*Aquilegia canadensis*	Red Columbine				SH	2 May Be At Risk	1	54.9 ± 10.0	NB
P	*Phleum alpinum*	Alpine Timothy				SH	2 May Be At Risk	3	74.0 ± 0.0	NB
P	*Gymnocarpium jessoense ssp. parvulum*	Asian Oak Fern				SH	2 May Be At Risk	12	57.4 ± 1.0	NB
P	*Botrychium campestre*	Prairie Moonwort				SH	2 May Be At Risk	1	51.2 ± 0.0	NB

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The recipient of these data shall acknowledge the ACCDC and the data sources listed below in any documents, reports, publications or presentations, in which this dataset makes a significant contribution.

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Appendix B BREEDING BIRD SPECIES DATA

Table B. 1 Breeding Bird Species Data

Common Name	Scientific Name	SARA	COSEWIC	NB SARA	AC CDC[1]	Data Sources	Highest Breeding Status
American Black Duck	Anas rubripes				S5B,S4N,S5M	AC CDC, MBBA	Confirmed
Ring-necked Duck	Aythya collaris				S5B,S5M	AC CDC	
Common Goldeneye	Bucephala clangula				S4B,S5M,S4N	MBBA	Confirmed
Ruffed Grouse	Bonasa umbellus				S5	AC CDC, MBBA	Possible
Spruce Grouse	Falcipennis canadensis				S5	MBBA	Confirmed
Pied-billed Grebe	Podilymbus podiceps				S4B,S4M	AC CDC, MBBA	Possible
Common Nighthawk	Chordeiles minor	Schedule 1, Threatened	Threatened	Threatened	S3B,S4M	AC CDC, MBBA	Possible
Ruby-throated Hummingbird	Archilochus colubris				S5B,S5M	MBBA	Possible
Wilson's Snipe	Gallinago delicata				S3S4B,S5M	AC CDC, MBBA	Possible
American Woodcock	Scolopax minor				S5B,S5M	AC CDC, MBBA	Possible
Spotted Sandpiper	Actitis macularius				S3S4B,S5M	MBBA	Possible
Common Loon	Gavia immer		Not at Risk		S4B,S4M,S4N	AC CDC, MBBA	Probable
American Bittern	Botaurus lentiginosus				S4B,S4S5M	MBBA	Possible
Osprey	Pandion haliaetus				S4S5B,S5M	MBBA	Possible
Red-tailed Hawk	Buteo jamaicensis		Not at Risk		S4	MBBA	Possible
Great Horned Owl	Bubo virginianus				S4	AC CDC, MBBA	Possible
Barred Owl	Strix varia				S5	AC CDC, MBBA	Probable
Belted Kingfisher	Megaceryle alcyon				S5B,S5M	AC CDC, MBBA	Possible
Yellow-bellied Sapsucker	Sphyrapicus varius				S5B,S5M	MBBA	Probable
Hairy Woodpecker	Picoides villosus				S5	MBBA	Confirmed
Northern Flicker	Colaptes auratus				S5B,S5M	MBBA	Confirmed
American Kestrel	Falco sparverius				S4B,S4S5M	MBBA	Confirmed
Merlin	Falco columbarius		Not at Risk		S5B,S5M	MBBA	Possible
Yellow-bellied Flycatcher	Empidonax flaviventris				S4S5B,S5M	AC CDC, MBBA	Possible
Alder Flycatcher	Empidonax alnorum				S5B,S5M	AC CDC, MBBA	Possible
Least Flycatcher	Empidonax minimus				S5B,S5M	AC CDC, MBBA	Possible
Blue-headed Vireo	Vireo solitarius				S5B,S5M	MBBA	Probable
Philadelphia Vireo	Vireo philadelphicus				S5B,S5M	AC CDC, MBBA	Probable
Red-eyed Vireo	Vireo olivaceus				S5B,S5M	AC CDC, MBBA	Possible
Gray Jay	Perisoreus canadensis				S4	MBBA	Confirmed

Table B. 1 Breeding Bird Species Data

Common Name	Scientific Name	SARA	COSEWIC	NB SARA	AC CDC[1]	Data Sources	Highest Breeding Status
Blue Jay	Cyanocitta cristata				S5	AC CDC, MBBA	Possible
Common Raven	Corvus corax				S5	AC CDC, MBBA	Possible
Tree Swallow	Tachycineta bicolor				S4B,S4M	AC CDC, MBBA	Possible
Barn Swallow	Hirundo rustica	Schedule 1, Threatened	Threatened	Threatened	S2B,S2M	AC CDC, MBBA	Possible
Black-capped Chickadee	Poecile atricapillus				S5	AC CDC, MBBA	Probable
Boreal Chickadee	Poecile hudsonicus				S4	AC CDC, MBBA	Possible
Red-breasted Nuthatch	Sitta canadensis				S5	AC CDC, MBBA	Confirmed
Brown Creeper	Certhia americana				S5	MBBA	Possible
Winter Wren	Troglodytes hiemalis				S5B,S5M	AC CDC, MBBA	Probable
Golden-crowned Kinglet	Regulus satrapa				S5	AC CDC, MBBA	Probable
Ruby-crowned Kinglet	Regulus calendula				S4B,S5M	AC CDC, MBBA	Possible
Swainson's Thrush	Catharus ustulatus				S5B,S5M	AC CDC, MBBA	Possible
Hermit Thrush	Catharus guttatus				S5B,S5M	AC CDC, MBBA	Confirmed
American Robin	Turdus migratorius				S5B,S5M	AC CDC, MBBA	Possible
Cedar Waxwing	Bombycilla cedrorum				S5B,S5M	MBBA	Confirmed
Purple Finch	Haemorhous purpureus				S4S5B,SUN,S5M	AC CDC, MBBA	Possible
White-winged Crossbill	Loxia leucoptera				S5	MBBA	Possible
Pine Siskin	Spinus pinus				S3	MBBA	Probable
Evening Grosbeak	Coccothraustes vespertinus	No Schedule, No Status	special concern		S3B,S3S4N,SUM	AC CDC	
Ovenbird	Seiurus aurocapilla				S5B,S5M	AC CDC, MBBA	Probable
Northern Waterthrush	Parkesia noveboracensis				S4B,S5M	MBBA	Possible
Black-and-white Warbler	Mniotilta varia				S5B,S5M	MBBA	Possible
Tennessee Warbler	Oreothlypis peregrina				S4B,S5M	AC CDC, MBBA	Possible
Nashville Warbler	Oreothlypis ruficapilla				S5B,S5M	AC CDC, MBBA	Confirmed
Mourning Warbler	Geothlypis philadelphia				S4B,S5M	MBBA	Possible
Common Yellowthroat	Geothlypis trichas				S5B,S5M	AC CDC, MBBA	Possible
American Redstart	Setophaga ruticilla				S5B,S5M	AC CDC, MBBA	Possible
Cape May Warbler	Setophaga tigrina				S3B,S4S5M	AC CDC, MBBA	Possible
Northern Parula	Setophaga americana				S5B,S5M	AC CDC, MBBa	Possible
Magnolia Warbler	Setophaga magnolia				S5B,S5M	AC CDC, MBBA	Possible
Bay-breasted Warbler	Setophaga castanea				S4B,S4S5M	AC CDC, MBBA	Possible
Chestnut-sided Warbler	Setophaga pensylvanica				S5B,S5M	AC CDC, MBBA	Possible
Blackpoll Warbler	Setophaga striata				S3S4B,S5M	MBBA	Possible

Table B. 1 Breeding Bird Species Data

Common Name	Scientific Name	SARA	COSEWIC	NB SARA	AC CDC[1]	Data Sources	Highest Breeding Status
Black-throated Blue Warbler	Setophaga caerulescens				S5B,S5M	AC CDC, MBBA	Possible
Palm Warbler	Setophaga palmarum				S5B,S5M	MBBA	Possible
Yellow-rumped Warbler	Setophaga coronata				S5B,S5M	AC CDC, MBBA	Confirmed
Black-throated Green Warbler	Setophaga virens				S5B,S5M	AC CDC, MBBA	Probable
Canada Warbler	Cardellina canadensis	Schedule 1, threatened	threatened	threatened	S3B,S3M	AC CDC, MBBA	Possible
Wilson's Warbler	Cardellina pusilla				S4B,S5M	MBBA	Possible
Chipping Sparrow	Spizella passerina				S5B,S5M	MBBA	Possible
Fox Sparrow	Passerella iliaca				S4B,S5M	AC CDC, MBBA	Possible
Song Sparrow	Melospiza melodia				S5B,S5M	MBBA	Possible
Swamp Sparrow	Melospiza georgiana				S5B,S5M	MBBA	Possible
White-throated Sparrow	Zonotrichia albicollis				S5B,S5M	AC CDC, MBBA	Possible
Dark-eyed Junco	Junco hyemalis				S5	AC CDC, MBBA	Probable
Red-winged Blackbird	Agelaius phoeniceus				S4B,S4M	AC CDC, MBBA	Possible
Common Grackle	Quiscalus quiscula				S5B,S5M	MBBA	Confirmed

NOTES:
[1] S1 = *critically imperiled*, S2 = *imperiled*, S3 = *vulnerable*, S4 = *apparently secure*, S5 = *secure*, SNA = not applicable (typically exotic species), S#S# = a numeric range rank used to indicate any range of uncertainty about the status of the species or community (AC CDC 2016b; 2017).
(1) Species at Risk (SAR) are indicated in **bold** text.