ATLANTIC GOLD

June 12, 2017

Canadian Environmental Assessment Agency
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Environmental Assessment Branch
Nova Scotia Environment
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To Whom It May Concern,

Atlantic Gold is pleased to continue to move forward the Environmental Assessment of its proposed Beaver Dam Mine Project.

Please find enclosed the Environmental Impact Statement (EIS) as per the *Canadian Environmental Assessment Act, 2012* and the Environmental Assessment Registration Document (EARD) as per Nova Scotia *Environmental Assessment Regulations*.

The undersigned has signing authority and submits the contents of the EIS / EARD as per the federal and provincial environmental assessment processes.

Any correspondence regarding the Environmental Assessment should be directed to the Chief Operating Officer, Maryse Bélanger at 604-689-5564 or mbelanger@atlanticgoldcorporation.com.

Sincerely,

Maryse Bélanger

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Chief Operating Officer

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Beaver Dam Mine Project
Environmental Impact Statement

Marinette, Nova Scotia

Prepared on behalf of: ATLANTIC GOLD

45 Akerley Boulevard Dartmouth Nova Scotia B3B 1J7 Canada

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Table ES-2 Commonly Used Acronyms

Acronym	Expanded Use
AMO	Abandoned Mine Opening
ANFO	Ammonium Nitrate and Fuel Oil
AQI	Air Quality Index
AQHI	Air Quality Health Index
ARD	Acid Rock Drainage
CAAQS	Canadian Ambient Air Quality Standards
CCME	Canadian Council of Ministers of the Environment
CEAA	Canadian Environmental Assessment Agency
CEAA 2012	Canadian Environmental Assessment Act, 2012
CEAR	Canadian Environmental Assessment Registry
CEPA	Canadian Environmental Protection Act
CFM	Cubic Feet per Minute
CIL	Carbon in Leach
CLC	Citizen Liaison Committee
CO	Carbon Monoxide
CO2 eq	Carbon Dioxide Equivalent Units
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
DFO	Fisheries and Oceans Canada
EA	Environmental Assessment
EARD	Environmental Assessment Registration Document
ECCC	Environment and Climate Change Canada
EIS	Environmental Impact Statement
FWAL	Freshwater Aquatic Life
GDP	Gross Domestic Product
GHG	Greenhouse Gas
HRM	Halifax Regional Municipality
IA	Industrial Approval
IR	Indian Reserve
LAA	Local Assessment Area
MBR	Migratory Birds Regulations
MCBA	Migratory Birds Convention Act, 1994
MEKS	Mi'kmaq Ecological Knowledge Study
MMER	Metal Mining Effluent Regulations
NOx	Oxides of Nitrogen
NAPS	National Air Pollution Surveillance Network
NPA	Navigation Protection Act, 1985
NPRI	National Pollutant Release Inventory
NRCAN	Natural Resources Canada

Table ES-2 Commonly Used Acronyms

Acronym	Expanded Use
NSAQS	Nova Scotia Air Quality Standards
NSCCH	Nova Scotia Department of Communities, Culture, and Heritage
NSDMA	Nova Scotia Department of Municipal Affairs
NSDNR	Nova Scotia Department of Natural Resources
NSE	Nova Scotia Environment
NSTIR	Nova Scotia Department of Transportation and Infrastructure Renewal
NWPA	Navigable Waters Protection Act, 1985 (repealed)
O3	Ozone
PA	Project Area
PM	Particulate Matter
PM2.5	Fine Particulate Matter
PM10	Coarse Particulate Matter
RAA	Regional Assessment Area
ROM	Run Of Mine
SAR	Species at Risk
SARA	Species at Risk Act, 2002
SO2	Sulphur Dioxide
SOCI	Species of Conservation Interest
TPM	Total Particulate Matter
TSS	Total Suspended Solids
USEPA	United States Environmental Protection Agency
VC	Valued Component

Table ES-3 Units of Measurement List

Unit	Expanded Use
cm/year	Centimetres per Year
g/t	Grams per Tonne
ha	Hectares
HZ	Hertz
km	Kilometre
kt	Kilotonne
kW	Kilowatt
m	Metres
masl	Metres Above Sea Level
mm	Millimetres
Mt	Megatonne
pphm	Parts per Hundred Million
t/y	Tonnes per Year
t/m3	Tonnes per Cubic Metre
µg/m3	Micrograms per Cubic Metre
V	Volt

Table ES-4 Useful Links

Resource/Document
Canadian Environmental Assessment Agency https://www.ceaa-acee.gc.ca/default.asp?lang=En
Canadian Environmental Assessment Agency - Environmental Assessment Registry https://www.ceaa-acee.gc.ca/050/index-eng.cfm
Canadian Environmental Assessment Agency - Beaver Dam Mine Project https://www.ceaa-acee.gc.ca/050/details-eng.cfm?evaluation=80111
Nova Scotia Environment Environmental Assessment https://novascotia.ca/nse/ea/
Nova Scotia Environment, Project Documents and Highlights - Surface Gold Mine at Moose River Gold Mines, Halifax County http://novascotia.ca/nse/ea/MooseRiver.asp
Environmental Assessment Document for the Touquoy Gold Project, Moose River Gold Mines, Nova Scotia, dated March 2007 http://novascotia.ca/nse/ea/MooseRiver/MooseRiver_Registration.pdf
Focus Report, Touquoy Gold Project, Moose River Gold Mines, Nova Scotia, dated November 2007 http://novascotia.ca/nse/ea/MooseRiver/FocusReportTouquoyGoldProject.pdf
Environmental Assessment Approval – Touquoy Gold Project, dated February 1, 2008 http://novascotia.ca/nse/ea/MooseRiver/MooseRiver_MinDecisionFinal.pdf

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1. Introduction

1.1 Project Overview

The Beaver Dam Mine Project (the Project) proposed by Atlantic Gold Corporation (Atlantic Gold) will operate as a satellite surface mine with an approximate ore extraction rate of 2 million tonnes per year (t/y). The Beaver Dam Mine Project is part of the Moose River Consolidated (MRC) Project. The MRC Project also includes the existing and fully permitted Touquoy Gold Project in nearby Moose River Gold Mines, Nova Scotia.

Processing of ore from the Beaver Dam gold deposit at the existing Touquoy plant will begin upon completion of mining ore from the Touquoy deposit. The Beaver Dam Mine Project is anticipated to begin construction in 2021, come into production in 2022, cease operations in 2026 and then be reclaimed.

The Project is subject to both federal and provincial environmental assessment (EA) processes. This document forms both the Environmental Impact Statement (EIS) and EA Registration Document (EARD) under the federal and provincial processes, respectfully.

This EIS/EARD for the Beaver Dam Mine Project has been prepared to facilitate the approval of the Project in accordance with the *Canadian Environmental Assessment Act, 2012* (*CEAA 2012*) and *Environmental Assessment Regulations* made under the *Nova Scotia Environment Act*. The EIS Guidelines (CEAA 2016) prepared by Canadian Environmental Assessment Agency (CEA Agency) have provided a framework for the organization of this EIS. No public money is being sought to undertake the Project.

The Project as presented in this document is comprised of three components:

- Mining and primary crushing of ore to be loaded onto trucks at the Beaver Dam mine site;
- Transporting ore from Beaver Dam along a 30.7 kilometers (km) haul road to existing facilities in Moose River; and
- Processing of ore and management of tailings at existing facilities developed as part of the Touquoy Gold Project.

The location of these Project components on a regional scale is displayed on Figure 1.1-1.

Physical activities specific to the operation of the Beaver Dam mine site will include mining of ore, crushing of ore, operation of till and waste rock storage facilities, and treatment of surface water runoff and mine discharge water through collection and settling ponds. No ore processing or tailings management will occur at the Beaver Dam mine site. Operational infrastructure will be minimal as those Project activities will use infrastructure at the Touquoy site in Moose River Gold Mines. Electrical power demand required for the Beaver Dam mine site is not anticipated to be substantial and will be supplied by on site generators. Petroleum products will be stored on-site for use in generators, operational equipment, and haul trucks.

Transporting ore from the Beaver Dam mine site to the existing Touquoy facilities is required for processing the ore and managing tailings. Portions of the haul road route (approximately 15.4 km) will require upgrading to a dual lane road to facilitate the safe passage of two-way truck traffic at a maximum speed of 70 km/h. Where possible, the upgrades will follow the course of the existing roadway; however, some adjustments to existing road alignment will be required to fulfill safe design standards. Another portion of the haul road route (approximately 4.0 km) will be new construction to allow the haul route to avoid traveling along Highway 224 and the Mi'kmaq community of Beaver Lake. The remainder of the haul route (approximately 11.3 km) is along a dual lane provincial road (i.e., Mooseland Road). The proposed haul route does not travel by any existing residences.

The Touquoy Gold Project underwent a review in 2007 to determine if an EA was required under the existing provincial and federal legislation. It was determined by Nova Scotia Environment (NSE) and the CEA Agency that only a provincial EA was required in accordance with the Nova Scotia *Environmental Assessment Regulations*. Under the *Canadian Environmental Assessment Act (1992)* and its pursuant regulations, there were no triggers for a federal EA when the Touquoy Gold Project was reviewed in 2007. The CEAA file number for the review is 10700-40. The Touquoy Gold Project obtained EA approval in 2008 and has since obtained additional approvals through the applicable provincial regulatory processes, including the Industrial Approval (IA); the Touquoy Gold Project is currently (2017) under construction as per its approvals.

Changes to the Touquoy Gold Project as a result of the Beaver Dam Mine Project will be assessed through this EA. They include: an increase in the duration of ore processing (approximately four additional years); minor adjustments to the ore processing facility; and disposal of Beaver Dam tailings in the exhausted Touquoy surface mine.

Due to the timing of the Beaver Dam ore being processed at the Touquoy site, the Beaver Dam tailings will not be stored in the Touquoy tailings management facility, but instead would be permanently stored in the pit after the Touquoy gold deposit has been mined. This allows the Touquoy Gold Project footprint to be maintained as permitted and no tailings management will be needed at the Beaver Dam mine site. All other aspects of the Touquoy Gold Project will remain as assessed and approved through the Nova Scotia EA process in 2008.

Following the production period for the Beaver Dam Mine Project, reclamation would occur at the Beaver Dam mine site and at facilities associated with ore processing and tailings management at the Moose River site due to processing Beaver Dam ore. Any changes to the current reclamation plan for the Touquoy Gold Project, as a result of the Beaver Dam Mine Project, would require approval by the Province of Nova Scotia.

1.2 Proponent Information

1.2.1 Proponent Profile

The Proponent, Atlantic Gold, is a well-financed, growth-oriented gold development group with a long-term strategy to create a mid-tier gold production group focused on manageable, executable projects in mining-friendly jurisdictions. Its board and management team, with extensive experience in geology, mining and mine development, process and metallurgy and project financing, is currently focused on the development of its project portfolio of advanced gold development properties located in Nova Scotia, Canada.

Currently, Atlantic Gold holds four gold development projects in Nova Scotia: the MRC Project comprising the Touquoy and the Beaver Dam gold deposits; the Cochrane Hill gold deposit; and the Fifteen Mile Stream gold deposit. The permitted Touquoy Gold Project is under construction with operation scheduled to begin in September 2017. The Beaver Dam Mine Project is in the permitting phase. Advanced exploration activities are underway at both Cochrane Hill and Fifteen Mile Stream.

The Proponent, formerly Spur Ventures Inc., was made aware of the permitted Touquoy Gold Project and other assets in Nova Scotia that were controlled by an Australian-listed company called Atlantic Gold NL. Upon completion of satisfactory due diligence, the two companies merged in August 2014 and Spur Ventures subsequently changed its name to Atlantic Gold Corporation (Atlantic Gold). Shortly after completing this merger, Atlantic Gold subsequently acquired Acadian Mining Corp from Lion Gold Mining Canada Inc. in September 2014. This acquisition gave Atlantic Gold access to the Beaver Dam property and other properties and holdings in Nova Scotia.

Environmental data collection began in September 2014 and diamond drilling began in October 2014 at the Beaver Dam site. In November 2014, Ausenco Engineering Canada Inc. (Ausenco) was commissioned by Atlantic Gold to complete the Project Feasibility Study and the NI 43-101 Technical Report for the co-development of the Touquoy and Beaver Dam deposits that is the MRC Project. For the Beaver Dam portion of the MRC Project, regulatory consultation began in October 2014 with a Provincial “One Window Process: Mineral Development in Nova Scotia” meeting to present the planned Project and to receive feedback on the regulatory regime and regional expertise.

The Beaver Dam property is held under a single mineral exploration license EL50421, currently held by Annapolis Properties Corporation, a wholly owned subsidiary of Acadian Mining which in turn is a wholly owned subsidiary of Atlantic Gold. License 50421 is comprised of 76 contiguous claims which cover an area of approximately 569 hectares. License 50421 is an amalgamation of EL05920 and EL06175 which was reissued as EL50421 in August 2014. License 05920 represented the amalgamation of three pre-existing exploration licenses; 00047, 04790 and 04516 which were acquired in 2002 by Tempus Corporation; Tempus subsequently became Acadian Gold and later Acadian Mining. The licenses were regrouped in 2003 as EL05920 and reissued by the Nova Scotia Department of Natural Resources (NSDNR) in 2005. Acadian owns 100% interest in license 50421; however, portions of the license are subject to differing agreements made prior to its acquisition by Tempus.

As the corporate entity that would develop, manage and operate the Project, Atlantic Gold is the parent company of subsidiaries which are listed on the Nova Scotia Registry of Joint Stocks: Annapolis Properties Corporation which holds the mineral exploration license EL50421 for the Beaver Dam property; and Atlantic Mining NS Corp. which holds the existing permits, leases and licenses for the Touquoy Gold Project.

1.2.2 Corporate Governance and Management Structure

Atlantic Gold is committed to the highest practical standards of corporate governance and to being a responsible corporate citizen. Safe production and environmental stewardship are keys to the

Atlantic Gold organization. The company relies upon its senior management team and Board of Directors who have extensive experience with past mining developments worldwide.

The current senior management team of Atlantic Gold:

- Steven Dean – Chairman, Chief Executive Officer (CEO) and Director
- Maryse Belanger – Chief Operating Officer (COO)
- Chris Batalha – Chief Financial Officer and Corporate Secretary
- John Thomas – VP Projects
- Alastair Tiver – VP Mine Development
- James Millard – Manager Environment and Permitting
- Neil Schofield – Consulting Resource Geologist
- Sean Thompson – Manager Investor Relations

The CEO reports to the eight-member Board of Directors:

- Steven Dean – Chairman and CEO
- John Morgan – Director
- Robert Atkinson – Director
- Wally Bucknell – Director
- William Armstrong – Director
- David Black – Director
- Donald Siemens – Director
- Ryan Beedie – Director

Traded on the Toronto Stock Exchange (TSX) as AGB-V, Atlantic Gold is committed to meeting or exceeding the standards set by the TSX Venture Exchange article and Canadian securities regulators. The Company has a Nominating and Corporate Governance Committee, an Audit Committee and a Compensation Committee, as well as policies and codes, such as Code of Conduct which includes obligations regarding environmental standards, health and safety, contributions to local communities, and respect and tolerance. Any breaches of this Code must be immediately reported to the Chair of the Nominating and Corporate Governance Committee.

The Board of Directors recently directed Atlantic Gold to develop an Environmental Management System (EMS) based on environmental risk. An EMS is viewed by the Board and senior management as key for due diligence from perspectives of fiscal, legal, social, and environmental responsibility. Development and implementation of the EMS with associated procedures in an Environmental Protection Plan (EPP) will include all phases of Atlantic Gold’s development projects, including exploration, construction to operation, maintenance, monitoring and ultimately closure, as well as integrate other aspects such as documentation. The EPP will also address specific contingency planning and spill response procedures.

The EMS will ensure mechanisms are in place such that corporate policies associated with fiscal, legal, social and environmental responsibility will be implemented and respected for the MRC Project. The overall responsibility to develop the EMS rests with the COO while technical development and implementation of the EMS and its EPP will be a key area of accountability of the Manager of Environment and Community Relations. Technical staff on site will be responsible for ensuring the EPP is implemented on a daily basis.

As part of its commitment to corporate responsibility and incorporation of best practices, Atlantic Gold has established a Geotechnical and Tailings Dam Review Board (Review Board) for design, construction and operation phases of the MRC Project. This includes tailings management, waste rock storage and open pit mining activities. Reporting to Atlantic Gold's COO, the Review Board is established to provide ongoing, independent confirmation to Atlantic Gold by internationally-recognized experts that the design, construction, operation and closure of the MRC Project conform with international best practice and to minimize impact in compliance with its permits and licenses. The Review Board is independent and its scope includes reviewing, commenting, questioning, critiquing and advising on all aspects of including, but not limited to:

- Engineering design;
- Construction practices;
- Operation and maintenance practices;
- Closure and post-closure requirements;
- Stability;
- Water management and treatment, including both surface and ground water;
- Geochemical considerations;
- Management systems;
- Budget and staffing;
- Emergency preparedness and response planning; and
- Community interaction.

Atlantic Gold intends to maintain suitable insurance and bonding to ensure its commitments are met. This includes maintaining financial bonding to ensure that adequate reclamation security is in place at all times during the construction, development and operational phases of the Company's mining projects, as well as appropriate environmental impairment liability insurance. As part of the existing Touquoy Gold Project, both reclamation security and environmental liability insurance are maintained as per requirements of the Province of Nova Scotia.

Further Atlantic Gold commits to completing its operations in adherence with best available practices (BAPs) and industry standards as per guides developed by Mining Association of Canada, such as the Towards Sustainable Mining initiative, and the Canadian Dam Association.

1.2.3 Proponent Personnel Details

A corporate office in Vancouver, British Columbia and a local office in Moose River Gold Mines, Nova Scotia are maintained in support of the MRC Project. Key management and technical staff will be located in both locations for the duration of the Beaver Dam Mine Project. The addresses for both office locations are provided in Table 1.2-1.

Table 1.2-1 Office Locations

Corporate Office	Local Office
Suite 3083, Three Bentall Centre 595 Burrard Street, P.O. Box 49298 Vancouver, British Columbia Canada V7X 1L3 Tel: (604) 689-5564 Fax: (604) 566-9050	6749 Moose River Road Moose River Gold Mines RR2 Middle Musquodoboit, Nova Scotia Canada B0N 1X0 Tel: (902) 384-2772

All communications regarding the EA for the Beaver Dam Mine Project should be sent to the Manager of Environment and Community Relations as directed by the COO. The contact information for these two roles is outlined in Table 1.2-2.

Table 1.2-2 Proponent Contacts

Position	Proponent
COO	**Maryse Bélanger** Vancouver, British Columbia Phone: (604) 689-5564 Email: mbelanger@atlanticgoldcorporation.com
Manager Environment and Permitting	**James Millard** Middle Musquodoboit, Nova Scotia Phone: (902) 384.2772 Email: jmillard@atlanticgoldcorporation.com

1.2.4 Environmental Assessment Study Team

The EIS was prepared by a consulting team comprised of GHD Limited (GHD) under contract to Atlantic Gold. GHD had direct input from McCallum Environmental Limited (MEL). GHD focused on physical and socio-economic Valued Components (VC), while MEL focused on biophysical VCs. GHD and MEL are consulting firms with extensive experience conducting environmental studies, assessments, and permitting for mining developments in Nova Scotia. Staff of Atlantic Gold provided input and review of the submission.

The contact information for the consulting team is listed in Table 1.2-3.

Table 1.2-3 EA Study Team

GHD Limited Team Leader	McCallum Environmental Limited Team Leader
Peter Oram, P.Geo. Phone: (902) 468-1248 Email: peter.oram@ghd.com 45 Akerley Blvd Dartmouth, Nova Scotia Canada B3B 1J7	Meghan Milloy, MREM Phone: (902) 446-8252 Email: meghan@mccallumenvironmental.com Unit 135, 2 Bluewater Road Bedford, Nova Scotia Canada B4B 1G7

Atlantic Gold, GHD, and MEL will be herein referred to as the "EA Study Team".

Sub-contractors and their role in completing supporting documentation for the preparation of this EIS are included in Table 1.2-4.

Table 1.2-4 Sub-contractors Providing Supporting Information

Sub-contractor	Contributing Role
Cultural Resource Management Group Limited	Prepared an archaeological assessment report for the Project
Confederacy of Mainland Mi'kmaq - Environmental Services	Prepared a Mi'kmaq Ecological Knowledge Study report for the Project
Peter Clifton and Associates	Prepared an assessment of potential open pit groundwater inflows for the Project
Allnorth Engineering, Consulting, Project Management, and Surveying	Reviewed the engineering feasibility of the new construction portion of the haul route
Opus International Consultants	Prepared Roadway Review – Beaver Dam Road to Mooseland Road
Ausenco Engineering Canada Incorporated	Prepared a feasibility study for the Project

1.3 Regulatory Framework and Role of Government

The federal, provincial, and municipal regulatory framework outlines requirements for the EA process, the permits required for construction, operation and reclamation, and the conditions under which the Project will be operated. General legislation that may be applicable to the Project is outlined in Table 1.3-1, while key legislation which directly drives the development of the EIS is explained in more detail in the coming sections.

Table 1.3-1 Legislation Potentially Applicable to the Project

Legislation	Physical Activity and/or Trigger	Regulatory Authority
FEDERAL		
CEAA 2012	Assessment due to the construction, operation, decommissioning of a gold mine with an ore production capacity greater than 600 tonnes per day.	CEAA
Fisheries Act	Potential authorization and compensation due to physical activities in wetlands, watercourses, and water bodies.	DFO
Fisheries Act – Metal Mining Effluent Regulations	Environmental Effects Monitoring program due to mining effluent discharge to aquatic habitat.	DFO
Migratory Birds Convention Act – Migratory Birds Regulations	Potential authorization due to physical activities potentially relocating birds and destroying their habitat.	ECCC
Species at Risk Act	Potential authorization due to physical activities potentially destroying SARA listed species and/or their habitat.	DFO/ECCC
Navigation Protection Act	Potential authorization to opt works out of the NPA regime that may have approvals in accordance with repealed NWPA.	TC
Canadian Environmental Protection Act	Promotes sustainable development through pollution prevention and the protection of the environment and human health from risks associated with toxic substances.	ECCC
Transportation of Dangerous Goods Act	The movement of dangerous goods to, form, and within the site must comply with applicable regulations under the Transportation of Dangerous Goods Act.	TC
PROVINCIAL		
Environment Act – EA Regulations – Schedule A	Assessment due to the construction, operation, decommissioning of a facility that extracts or processes metallic or non-metallic minerals.	NSE
Environment Act – Activities Designation Regulations	Industrial Approval for the construction, operation, or reclamation of a surface mine using explosives and procuring mineral bearing ore.	NSE
Environment Act – Activities Designation Regulations	Water approval and/or notification for water withdrawal, alteration of water bodies, watercourses, and/or wetlands.	NSE
Environment Act – Air Quality Regulations	Ambient air quality standards for baseline environmental conditions discussion.	NSE
Special Places Protection Act and Regulations	Authorization required prior to conducting intrusive archaeological work.	NSCCH

Table 1.3-1 Legislation Potentially Applicable to the Project

Legislation	Physical Activity and/or Trigger	Regulatory Authority
Wildlife Act	Prohibits taking, hunting, killing or possessing eagles, osprey, falcons, hawks, owls, and any other protected wildlife.	NSDNR
Endangered Species Act	Prohibits killing, injuring, disturbing, taking, or interfering with endangered or threatened species and/or their habitat.	NSDNR
Crown Lands Act	Crown Lands Lease due to new haul road construction being located on Crown Lands.	NSDNR
Municipal Government Act	Authorizes municipalities to develop Municipal Planning Strategies and Land Use By-laws.	NSDMA
MUNICIPAL		
National Building Code of Canada	Approval for construction and occupation of buildings.	HRM

The Project is also driven by guidelines, policies, and standards that may be applicable during design, construction, operation, and reclamation. Those that may potentially be applicable to the Project are listed below, while key guidance documents which are directly applicable to the development of the EIS are listed in the coming sections**.**

Federal

- Canadian Council of Ministers of the Environment (CCME) Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life (FWAL) (CCME 1999a);
- CCME Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health (CCME 1999b);
- CCME Canadian Sediment Quality Guidelines for the Protection of Aquatic Life (CCME 2001);
- CCME Canada Wide Standards for Particulate Matter (PM) and Ozone (CCME 2010);
- Environmental Codes of Practice for Metal Mines (ECCC 2009);
- Guidelines for the Assessment of Alternatives for Mine Waste Disposal (ECCC 2011);
- Streamlining the Approvals Process for Metal Mines with Tailings Impoundment Areas (ECCC 2012);
- Guidance Document for Flow Measurement of Metal Mining Effluents (ECCC 2001);
- Guidance Document for Sampling and Analysis of Metal Mining Effluents (ECCC 2002);
- Guide for Reporting to the National Pollutant Release Inventory (NPRI) 2016 and 2017 (ECCC 2016a); and
- Federal Policy on Wetland Conservation (ECCC 1991).

Provincial

- Guidelines for Environmental Noise Measurement and Assessment (NSE 1990);
- Toward a Greener Future: Nova Scotia's Climate Change Action Plan (NSE 2009);
- Guide to Consider Climate Change in Project Development in Nova Scotia (NSE 2011a);
- Nova Scotia Wetland Conservation Policy (NSE 2011b);
- From Strategy to Action, An Action Plan for the Path We Share, A Natural Resource Strategy for Nova Scotia (NSDNR 2011a);
- The Path We Share: A Natural Resource Strategy for Nova Scotia 2011-2020 (NSDNR 2011b);
- Water for Life: Nova Scotia's Water Resource Management Strategy (NSE 2010);
- Nova Scotia Standard Specifications: Highway Construction and Maintenance (NSTIR 1997);
- Erosion and Sediment Control Handbook for Construction Sites (NSE 1988);
- Guide to Altering Watercourses (NSE 2015a);
- Nova Scotia Watercourse Alterations Standard (NSE 2015b);
- Generic Environmental Protection Plan for Construction of 100 Series Highways (NSTIR 2007);
- Storm Drainage Works Approval Policy (NSE 2002a).

Municipal

- Musquodoboit Valley/Dutch Settlement Municipal Planning Strategy (HRM 1996a);
- Musquodoboit Valley/Dutch Settlement Land Use By-law (HRM 1996b);
- Eastern Shore (East) Municipal Planning Strategy (HRM 1996c); and
- Eastern Shore (East) Land Use By-law (HRM 1996d).

1.3.1 Federal Regulatory Framework

1.3.1.1 Canadian Environmental Assessment Act, 2012

CEAA 2012 regulates the Government of Canada's EA process and the *Regulations Designating Physical Activities* (amended December 31, 2014) specify the physical activities to which *CEAA 2012* applies. The Beaver Dam Mine Project is a designated project in accordance with Section 16(c) of these *Regulations*, as it is a project which involves:

The construction, operation, decommissioning, and abandonment of a new rare earth element mine or gold mine, other than a placer mine, with an ore production capacity of 600 t/day or more.

Key regulatory events in accordance with *CEAA 2012* which have given rise to the completion of this EIS are provided in Table 1.3-2. Additional details for all of these events can be found on the Canadian Environmental Assessment Registry (CEAR).

Table 1.3-2 Timeline of Events in Accordance with CEAA 2012

Date	Event
October 16, 2015	Atlantic Gold and GHD submit a Project Description document to CEAA in order to initiate the EA determination process (GHD 2015).
October 19, 2015	CEAA releases a public notice inviting comments on the Project Description document in order to acquire assistance in the EA determination process. The public has 20 days to comment.
December 3, 2015	CEAA releases the Notice of EA Determination indicating that a federal EA is required for the Beaver Dam Mine Project.
December 7, 2015	CEAA releases the Notice of Commencement of an EA.
December 7, 2015	CEAA releases the draft EIS Guidelines and a public notice inviting comments on the guidelines in order to ensure they reflect which aspects of the environment may be affected and should be examined during the EA. The public has 37 days to comment.
January 19, 2016	CEAA releases the final EIS Guidelines specific to the Beaver Dam Mine Project.
January 25, 2016	CEAA releases a public notice inviting eligible individuals and groups to apply for federal funding in order to enable their participation in the upcoming steps of the environmental assessment.
April 29, 2016	CEAA releases the results of funding allocation for participation in the upcoming steps of the environmental assessment.
Project Initiation to March 2017	Baseline data collection, engagement with regulators, stakeholders, and Mi'kmaq, and drafting of the EIS.
March 27, 2017	Atlantic Gold submits the Beaver Dam Mine Project EIS for conformity review.
April 27, 2017	CEAA issues a letter providing the outcome of the Beaver Dam Mine Project EIS conformity review.
June 2, 2017	Atlantic Gold re-submits the Beaver Dam Mine Project EIS for conformity review.

Following re-submission of this EIS to CEAA, another public notice will be released inviting comment; the government review will be completed in conjunction with this public review period. CEAA will then prepare and publish a draft EA report which considers all public and government comments, and details conclusions regarding the potential for environmental effects from the Beaver Dam Mine Project. The draft EA report will be subject to another public review period before being finalized. Once finalized, the Minister of the Environment will complete a review and issue a decision, which will include a determination of significance of environmental effects. The Project is contingent upon an approved EA decision statement that allows the Project to proceed.

1.3.1.2 Fisheries Act, 1985

The *Fisheries Act* is administered by Fisheries and Oceans Canada (DFO) and generally protects the sustainability and productivity of recreational, commercial, and indigenous fisheries in Canada.

Under Section 35(1) *no person shall carry on any work, undertaking, or activity that results in serious harm to fish that are part of a commercial, recreational, or Aboriginal fishery, or fish that support such a fishery* unless authorized by or carried on in accordance with regulations issued in accordance with the *Fisheries Act*. In addition, Section 36(3) prohibits the discharge or deposition of *a deleterious substance in water frequented by fish* unless authorized or carried on in accordance with those same regulations.

As a result of anticipated physical activities potentially occurring in wetlands, watercourses, and water bodies, authorization in accordance with Section 35(2) of the *Fisheries Act* may be required.

Metal Mining Effluent Regulations

The Metal Mining Effluent Regulations (MMER) are made under the Fisheries Act and apply to mines that exceed an effluent flow rate of $50m^3$ per day, based on effluent deposited from all final discharge points of the mine and deposit a deleterious substance in any water or place referred to in subsection 36(3) of the Act.

As a result of anticipated collection and discharge of surface water runoff and mine discharge water through settling ponds, effluent monitoring in accordance with the Section 2(1) of the MMER may be required.

1.3.1.3 Migratory Birds Convention Act, 1994

Section 5 of the *Migratory Birds Convention Act* (*MBCA*) protects migratory birds, their nests, and their eggs from hunting, trafficking, and commercialization. A permit is required to disturb, destroy, or take a nest, egg, nest shelter, eider duck shelter, or duck box of a migratory bird.

In addition, Section 5.1 of the *MCBA* prohibits the discharge or deposition of a substance harmful to migratory birds *in waters or an area frequented by migratory birds or in a place from which the substance may enter such waters or such an area*. The discharge or deposition of a substance that may combine with a substance already present to create a harmful substance is also prohibited in Section 5.1.

Migratory Birds Regulations

The *Migratory Birds Regulations* (*MBR*) is made under the *MBCA* and may apply to the Project as a result of anticipated physical activities potentially relocating birds and destroying their habitat. An authorization in accordance with Section 4(1) of the *MBR* may be required.

1.3.1.4 Species at Risk Act, 2002

The *Species at Risk Act* (SARA) protects wildlife species from becoming extinct through prohibitions against killing, harming, harassing, capturing or taking species at risk (SAR), and against destroying their critical habitats. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) identifies species of special concern that may then qualify for legal protection and recovery in accordance with *SARA*. *SARA*'s mandate is to provide for the recovery of SAR and to ensure through sound management that species of concern do not require *SARA* listing. DFO is responsible for aquatic SAR, while ECCC is responsible for terrestrial SAR.

As a result of anticipated physical activities potentially occurring in wetlands, watercourses, and water bodies, as well as the potential destruction of sensitive terrestrial habitat, authorization in accordance with SARA may be required.

1.3.1.5 Navigation Protection Act, 1985

The *Navigation Protection Act* (*NPA*), formerly the *Navigable Waters Protection Act* (*NWPA*), was amended in April 2014 and effectively changed the definition of navigable water under this legislation.

Prior to the most recent amendment, navigable waters included all bodies or courses of water that were capable of being navigated by any type of floating vessel for transportation, recreation, or commerce. This definition created the need for works in, on, under, or over any water body or watercourse to obtain a Navigable Waters Protection Approval.

Following the most recent amendment, a schedule was added to the *NPA* that lists scheduled waters for which regulatory approval is required for works that risk a substantial interference with navigation. The schedule lists three oceans, 62 rivers, and 97 lakes, none of which are located in the area of the Project.

Although no scheduled waters are located in the area of the Project, works completed prior to the most recent amendment may have obtained a Navigable Waters Protection Approval in accordance with the repealed *NWPA*, which are still valid in accordance with the *NPA*.

As a result of anticipated physical activities potentially occurring in, on, under, or over a watercourse or water body, authorization from Transport Canada (TC) to opt the works out of the *NPA* regime may be required. The opt-out option must be exercised by April 1, 2019 (NPA 2014). Atlantic Gold will identify to TC the existing crossings on which alternations/work are being proposed and will opt out of the *NPA* regime as required. A full list of watercourses and water bodies located within the mine site and haul road PA is provided in Tables 6.3-3 to 6.3-5.

1.3.1.6 Federal Guidance Applicable to the Project

In addition to the EIS Guidelines developed for the Project, other guidance documents from CEAA that have been consulted include but are not limited to:

- Operational Policy Statement Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012 (CEAA 2013a);
- Operational Policy Statement Addressing “Purpose of” and “Alternative Means” under the Canadian Environmental Assessment Act, 2012 (CEAA 2013b);
- Operational Policy Statement Determining Whether a Designated Project is Likely to Cause Significant Adverse Environmental Effects under the Canadian Environmental Assessment Act, 2012 (CEAA 2015a);
- Draft Technical Guidance for Assessing Cumulative Environmental Effects Under the Canadian Environmental Assessment Act, 2012 (CEAA 2014a); and

- Technical Guidance for Assessing Physical and Cultural Heritage or any Structure, Site, or Thing that is of Historical, Archaeological, Paleontological, or Architectural Significance under the Canadian Environmental Assessment Act, 2012 (CEAA 2014b).

1.3.2 Provincial Regulatory Framework

1.3.2.1 Environment Act, 1995

Environmental Assessment Regulations

The Environmental Assessment Regulations made under Section 49 of the *Environment Act* regulates the Government of Nova Scotia's EA process. Projects that trigger the EA process are sub-divided into two classes – Class I and Class II. The Beaver Dam Mine Project triggers a Class I EA in accordance with Schedule A, Section B (1a) of these regulations, as it is a project which involves:

- A facility that extracts or processes metallic or non-metallic minerals.

This EIS will substitute and fulfill all the requirements of a provincial Environmental Assessment Registration Document (EARD). Table ES-1 outlines the requirements of the EARD and how they have been addressed in the EIS.

Activities Designation Regulations

Many of the provincial permits anticipated to be required for the Beaver Dam Mine Project are regulated in accordance with the *Activities Designation Regulations* made under Section 66 of the *Environment Act*. An Industrial Approval (IA) will be required in accordance with Section 16(2d) of these regulations, as it is a project that involves:

- A surface mine where an opening or excavation is made in the ground from the surface which may require the use of explosives for the purpose of procuring any mineral bearing ore, including coal, and any associated infrastructure.

The IA process, known as Part V of the *Environment Act* seeks to guide the proponent in determining the way in which a project, after EA Approval, is to be monitored for compliance targets, objectives set through the EA process, and commitments made by proponents through various means such as public and Indigenous Peoples consultation. It is a well understood process by AGC, having been part of the process for the existing Touquoy operation that has an IA.

Activities required to facilitate the Beaver Dam Mine Project, including wetland and watercourse alteration and groundwater and surface water withdrawals, may require approvals in accordance with these regulations as well. These permitting requirements will be initiated once EA approval has been received from the province.

1.3.2.2 Provincial Guidance Applicable to the Project

Provincial guidance documents that have been consulted in preparation of this EIS include:

- A Proponents Guide to Environmental Assessment (NSE 2001);

- Guide to Preparing an EA Registration Document for Mining Developments in Nova Scotia (NSE 2002b);
- Guide to Considering Climate Change in Environmental Assessment in Nova Scotia (NSE 2011c); and
- Guide to Addressing Wildlife Species and Habitat in an EA Registration Document (NSE 2005).

1.3.3 Municipal Regulatory Framework

The Halifax Regional Municipality is divided into 21 community plan areas that have their own set of land use strategies and by-laws. The Beaver Dam Mine Project straddles the boundary of the Musquodoboit Valley/Dutch Settlement Plan Area and the Eastern Shore (East) Plan Area.

The Beaver Dam mine site and Touquoy processing and tailings management facility are located in the Musquodoboit Valley and Dutch Settlement Plan Area. The Land Use By-law and Municipal Planning Strategy for this area were last amended in October 2014. The area is zoned mixed use, and extractive facilities, of which mining related infrastructure is one, are permitted within this zoning designation. The by-law for mixed use land use prescribes minimum separation distances from features such as lot lines, dwellings, watercourses, domestic wells, and residential zones. The physical activity of mining or extraction is not specified in the by-law as it is governed in the provincial and federal regulatory regime (pers. comm. L. Walsh 2016). The Municipal Planning Strategy describes mining as an important land use within the Plan Area from an economic perspective; however, extractive operations can potentially create harmful environmental effects. The Municipal Planning Strategy also states *these concerns are addressed by the provincial Department of Environment through their permitting process*.

The majority of the haul road is located in the Eastern Shore (East) Plan Area, while a minor portion is located in the Musquodoboit Valley and Dutch Settlement Plan Area. The area is zoned mixed use under the Musquodoboit Valley and Dutch Settlement Land Use By-law, and rural resource under the Eastern Shore (East) Land Use By-law. Haul roads are not specified in either by-law as these are governed in the provincial regulatory regime (pers. comm. L. Walsh 2016).

1.3.4 Indigenous Peoples

In 2004 and 2005, the Supreme Court of Canada decided the Crown (provincial and federal) has a duty to consult with Indigenous Peoples when contemplating decisions or actions that may adversely affect their established or potential indigenous rights and treaty rights. The provincial government typically delegates certain procedural aspects of this consultation to the proponent of a project. The federal government always acts as the consultation coordinator to integrate the Government of Canada’s indigenous consultation activities into the EA process. This duty cannot be delegated to proponents.

The Made-in-Nova Scotia Process is the forum for the Mi'kmaq, Nova Scotia and Canada to resolve issues related to Mi'kmaq treaty rights, Aboriginal rights, including Aboriginal title, and Mi'kmaq governance. The process involves the Mi'kmaq of Nova Scotia as represented by the Assembly of Nova Scotia Mi'kmaq Chiefs and the provincial and federal governments.

Through the provincial Indigenous Peoples consultation process, the EA Study Team was delegated aspects of the consultation. This engagement of the Mi'kmaq of Nova Scotia by the Proponent referenced two key guidance documents which have influenced the EA process for the Project:

- Proponents' Guide: The Role of Proponents in Crown Consultation with the Mi'kmaq of Nova Scotia (NSOAA 2009); and
- Mi'kmaq Ecological Knowledge Study Protocol, 2nd Edition (KMKNO 2007).

Other pertinent guidance in the federal regulatory framework which has influenced the EA process for the Project includes:

- Aboriginal Consultation and Accommodation – Updated Guidelines for Federal Officials to Fulfill the Duty to Consult (AANDC 2011);
- Technical Guidance for Assessing the Current Use of Lands and Resources for Traditional Purposes under the Canadian Environmental Assessment Act, 2012 (CEAA 2015b)
- Reference Guide Considering Aboriginal Traditional Knowledge in Environmental Assessments Conducted Under the Canadian Environmental Assessment Act, 2012 (CEAA 2014c).
- In Nova Scotia, treaty rights were established in law following the 1999 decision in the Donald Marshall Jr. case which confirms the right of the Mi'kmaq to hunt, fish, and gather to earn a moderate livelihood. These are protected under Section 35 of the Constitution Act, 1982.

1.4 Purpose of the Project

The implementation of the Beaver Dam Mine Project will provide additional ore to the existing Touquoy processing plant. This will extend the life of the MRC Project to continue to provide economic and social benefits with minimal additional infrastructure. Completing the Project with safe production, environmental stewardship and community engagement is key for Atlantic Gold to ensure that the Proponent, the Province, the community, and the Mi'kmaq of Nova Scotia have maximum benefit.

Worldwide annual gold production is about 2500 to 3000 tonnes. Gold is used primarily for jewelry and as a storage form of wealth with China and India forming the majority of the demand. Canada produced about 5% of the world total in past years. With Atlantic Gold's four gold development projects in Nova Scotia, there is much opportunity to supply gold with existing and expected future demand.

Atlantic Gold has recognized that the quantity and unusual style of gold mineralization at the Beaver Dam mine site will support a commercially viable surface mining operation with on-site crushing and off-site processing of ore. The amount of gold expected to be recovered will represent more than one-third of the gold produced from the historic goldfields of Nova Scotia since the 1860s.

Atlantic Gold wishes to develop this resource in line with all applicable regulatory requirements and recognizes the significant potential benefits to the local economy, the Province of Nova Scotia, the Mi'kmaq of Nova Scotia and the company in completing this Project. Atlantic Gold has designed a project that is in line with the intent of NSDNR for efficient use of mineral resources and to "*promote* *the concepts of environmental responsibility and sustainable development, stewardship of the mineral resource sector, and integrated resource planning.*"

All phases of the Project will provide employment opportunities for local residents and Indigenous Peoples, as well as provide tax revenue for the municipal, provincial, and federal levels of government. It is anticipated that additional labour force will be required during construction and a smaller, but still significant, labour force will be required during operation. Indirect employment will be generated by the Project through the use of external contractors and suppliers. Tax revenue in the millions of dollars per year will be generated through corporate income taxes paid by Atlantic Gold, as well as its contractors and suppliers. Socio-economic benefits that will occur as a result of the Project are discussed further in Section 1.6.2.

1.5 Guiding Principles

1.5.1 Planning Tool

At its foundation, EA is a planning tool used to ensure that projects are carefully planned to avoid or mitigate possible negative environmental effects and to maximize potential benefits. Use of the EA process early in a project's planning phase can be used to encourage proponents to develop their projects in the most sustainable manner. The use of the EIS Guidelines required Atlantic Gold to carefully review and consider the Project, including its alternatives, and the potential effects on valued components

1.5.2 Public Participation

The EIS Guidelines require that Atlantic Gold provide current information about the Project to the general public and especially the communities likely to be most affected by Project activities. Within the provincial and federal EA processes, there are distinct public comment periods, including the opportunity to comment on the EIS. To maximize public participation, proponents are required engage the public directly and early on in the EA process.

Atlantic Gold has been engaging stakeholders, including the local community, non-governmental organizations, governmental departments, and the local community since planning and permitting began on the Touquoy Gold Project over a decade ago. More specific to Beaver Dam Mine Project, specific engagement activities occurred in past year to facilitate public participation. This included open houses in May 2016, presentations and meeting with community organizations and expansion of the existing Community Liaison Committee (CLC).

Comments from the public were considered in the development of the EIS in terms of planning the Project and its assessment for each VC; responses from Atlantic Gold are documented in this EIS.

Refer to Section 3 of this EIS for additional details regarding the public consultation and engagement program.

1.5.3 Indigenous Engagement

The EIS Guidelines require that Atlantic Gold engage with Indigenous Groups that may be affected by the Project.

Within the provincial and federal EA processes and as part of the Made-in-Nova Scotia Process, there are distinct consultation processes completed by the Crown. To maximize engagement of Indigenous Peoples in the EA process, proponents are required engage Indigenous Peoples directly and early on in the EA process.

Atlantic Gold engaged with the Mi'kmaq of Nova Scotia to obtain views on:

- Effects of changes to the environment on the Mi'kmaq of Nova Scotia, specifically: health and socio-economic conditions; physical and cultural heritage, including any structure, site or thing that is of historical, archaeological, paleontological or architectural significance; and current use of lands and resources for traditional purposes; and
- Potential adverse impacts of the Project on potential or established Aboriginal or Treaty rights, title and related interests, in respect of the Crown's duty to consult, and where appropriate, accommodate the Mi'kmaq of Nova Scotia.

The information gathered by the proponent during its engagement with Indigenous Peoples helps to contribute to the Crown's understanding of any potential adverse impacts of the Project on potential or established Aboriginal or treaty rights, title and related interests, and the effectiveness of measures proposed to avoid or minimize those impacts.

Atlantic Gold has been engaging the Mi'kmaq of Nova Scotia since planning and permitting began on the Touquoy Gold Project over a decade ago. More specific to the Beaver Dam Mine Project, specific engagement activities occurred in past year to engage the Mi'kmaq of Nova Scotia. This included open houses in May 2016, many presentations and meetings with different Mi'kmaq groups, and expansion of the existing CLC to include representatives of the two nearest Mi'kmaq communities, Millbrook First Nation and Sipekne'katik First Nation.

Comments from the Mi'kmaq of Nova Scotia were considered in the development of the EIS in terms of planning the Project and its assessment for each VC; responses from Atlantic Gold are documented in this EIS. Refer to Section 4 of this EIS for additional details regarding the Indigenous Peoples consultation and engagement program.

1.5.4 Precautionary Approach Application

The EIS Guidelines require that Atlantic Gold demonstrate how all aspects of the Project have been examined and planned in a precautionary manner to avoid serious or irreversible environmental effects. This EIS applies the precautionary approach through the following assessment methodologies:

- provides extensive detail about the existing environment and develops mitigation measures to eliminate, reduce, or control the effect Project activities have on the environment;
- considers project design that will minimize disturbance to the existing environment;
- outlines contingency plans that address worst-case accidents and malfunctions;
- outlines follow-up and monitoring programs to verify project activity related impact predictions; and

- anticipates other projects in the area in an effort to eliminate, reduce, or control cumulative effects.

The application of a precautionary approach in developing this EIS will allow the EA to act as a planning tool which will be used to ensure the Project avoids or mitigates potential environment effects and promotes sustainable development.

1.6 Benefits of the Project

1.6.1 Environmental Benefits

The environmental benefits of the Project to Nova Scotia are numerous to correct past practices with respect to the environment. Given the area has been subjected to extensive exploration, mining, and logging activity over the past 150 years, baseline conditions show obvious effects from these historic activities. The current condition of the Beaver Dam mine footprint is disturbed and fragmented habitat based on significant timber harvesting, associated road building and yarding areas and historic exploration/mining activity. The Project Area (PA) contains a diversity of habitat types and landscape features, but has experienced a considerable amount of disturbance and habitat fragmentation as a result of these activities. The level of disturbance within the mine footprint PA disproportionately affects uplands, over wetlands. As such, the level of new fragmentation associated with the mine footprint PA is anticipated to be moderate, given the current level of disturbance.

The poor condition of the majority of existing haul road culvert crossings directly contributes to poor surface water quality and fish passage in watercourses and wetlands along the Beaver Dam Mines Road and the Moose River Cross Road. Upgrades to this existing haul road will include culvert replacements at the 20 locations and 3 new bridges, where determined to be necessary. It is expected that correctly installed culverts will increase fish passage and positively affect fish habitat through improved surface water quality.

All baseline environmental investigations for the Project have added to the scientific understanding of the area and improved background data held by the province. Background data helps increase the knowledge base of its users and thus increases public ecological awareness and promotes conservation of natural ecosystems.

At closure, reclamation will occur on the Beaver Dam mine site and the facilities at the Touquoy Gold Project. This reclamation plan will be secured with a bond held by the Province of Nova Scotia to ensure there are sufficient funds to reclaim the site at any point during the Project. The plan for reclamation requires approval of the Nova Scotia Department of Natural Resources.

1.6.2 Socio-economic Benefits

KPMG International completed an Economic Impact Assessment of the Moose River Consolidated (MRC) Project to evaluate the economic benefits stemming from Atlantic Gold's mining projects in Nova Scotia (KPMG 2015). This assessment considered the Touquoy and Beaver Dam Mine Projects together and found that socio-economic benefits will stem primarily from the construction and operation phases of the Beaver Dam Mine Project.

Construction activities will involve preparing the mine site, setting up infrastructure and facilities, and purchasing mining processing equipment to enable the MRC Project to reach full production. Much of the spending associated with these activities will be incurred in Nova Scotia and Canada. As per the KPMG report, it was projected that construction costs will be approximately $146 million, with approximately $97.6 million, or 67%, being spent in Nova Scotia, and approximately $111.9 million, or 77%, being spent in Canada. As a result of this spending, it is anticipated that 391 full time equivalent jobs will be created in Nova Scotia per year during construction. For Canada as a whole, the construction phase will create 437 full time equivalent jobs per year. Tax revenues stemming from the construction phase are expected to be $4.1 million for the Government of Nova Scotia and $5.5 million for the Government of Canada. This is a conservative estimate as corporate income taxes paid by contractors and suppliers cannot be estimated.

Operational mining and processing activities will involve the deployment and operation of new mining production capacity. Similar to the construction phase, much of the spending associated with operation of the MRC Project will be incurred in Nova Scotia and Canada. As per the KPMG report, it was projected that annual operating costs will be approximately $52.3 million, with approximately $38.1 million, or 73%, being spent in Nova Scotia, and approximately $39.4 million, or 75%, being spent in Canada. The costs include several spending components, the most important being:

- salaries and benefits for 27% of total annual operating costs;
- cyanide, lime, and reagents for 24% of total annual operating costs;
- diesel for 22% of total annual operating costs;
- wear parts and spare parts for 15% of total annual operating costs; and
- electricity (Touquoy only) for 7% of total annual operating costs.

As a result of this spending, it was anticipated in the KPMG report that 228 yearly and recurrent full time equivalent jobs will be created in Nova Scotia during operation. For Canada as a whole, the operation phase will create 278 yearly and recurrent full time equivalent jobs during operation. Tax revenues stemming from the operation phase are expected to be $10.2 million annually for the Government of Nova Scotia and $8.1 million annually for the Government of Canada. These represent conservative estimates as corporate income taxes paid by suppliers cannot be estimated.

The Province of Nova Scotia's unemployment rate is higher than the national average (8.8%>6.9%) and its gross domestic product (GDP) growth has been the slowest of all Canadian provinces. In addition, the GDP per capita is the second lowest in Canada. The MRC Project would greatly benefit the Province of Nova Scotia due to substantial upfront investments and significant annual operation costs contributing to job creation and government tax revenue.

Atlantic Gold is committed to working with the local community and the Mi'kmaq of Nova Scotia to maximize socio-economic benefits as the Company developments its projects in the Province, including the Beaver Dam Mine Project.

2. Project Description

2.1 Project Location and History

The Beaver Dam Mine Project, as proposed, encompasses three primary locations from Marinette to Moose River Gold Mines, Halifax County, Nova Scotia. The Beaver Dam mine site will be located at the end of the Beaver Dam Mines Road in Marinette and the haul road will span from the Beaver Dam mine site to Moose River Gold Mines where the Touquoy processing and tailings management facility is located.

The Beaver Dam mine site is in an area of low topographic relief. The majority of the area is at 140 metres above sea level (masl) with scattered drumlins reaching 165 to 175 masl and Cameron Flowage channeling through a topographic low of 130 masl. Drainage is to the southeast along a number of poorly drained streams, shallow lakes, and wetlands. The Beaver Dam gold deposit is located in an area of Nova Scotia dominated by the Meguma Supergroup, consisting of a thick basal greywacke Goldenville Group and a thick overlying, finer grained, argillite Halifax Group. Mineralization at the Beaver Dam Property occurs in the north-dipping southern limb of an overturned anticline with gold hosted both within quartz veins and disseminated through the intervening inter-bedded argillite and greywacke.

No federal lands will be used to undertake the Project. The nearest federal lands are the Beaver Lake Indian Reserve (IR) 17, which is a satellite community of the Millbrook First Nation and located approximately 5 km southwest of the Beaver Dam mine site. At its nearest point, the haul road route is approximately 3 km east of Beaver Lake IR 17. No federal lands are located in close proximity to the Touquoy processing and tailings management facility. Figure 2.1-1 displays all three locations and the ownership of land in which they occupy.

All blasting will occur more than 5 km away from any residential structures. There are no hospitals, retirement hospices, schools or day care centres located within 20 km of the site. Hwy 224 is the nearest access point to the mine located approximately 7 km from the site. There is no residential development in the vicinity of the Project. The closest point to permanent residences is 5.7 km south of the mine at Beaver Lake IR on Hwy 224. Three seasonal residences are located within 100 m of the haul road, as noted on Figure 2.1-2.

2.1.1 Beaver Dam Mine Site

The Beaver Dam mine site will be developed on approximately 145 hectares (ha) of land owned by the Northern Timber Nova Scotia Corporation (Northern Timber) in Marinette, Halifax County, Nova Scotia. Access to this land for mining purposes will be granted by a lease agreement between Northern Timber and Atlantic Gold. The approximate centre point of the mine site is 522230 E 4990025 N (UTM Zone 20 NAD83 CSRS).

The area is described as having low topographic relief with average elevations of approximately 140 masl and scattered drumlins reaching approximately 165 to 175 masl. Drainage in the area is generally southeast along a number of poorly drained streams, shallow lakes, and wetlands that flow out into Cameron Flowage (130 masl) and the Killag River; however a drainage divide is present inside the southwest boundary of the mine site that drains water to the south through Paul

Brook. The Beaver Dam mine site is bordered on all sides by forest in various stages of regrowth due to logging activities in the region, and waterbodies, watercourses, and wetlands draining several catchment areas within the Project area.

The area has been subject to exploration and mining activity since gold was first discovered in 1868. Between 1871 and 1949, there were intermittent attempts to develop and mine the area, initially focused on the Austen Shaft area and later on the Mill Shaft area located approximately 1.2 km west of the Austen Shaft. The small Papke Pit located approximately 400 m west of the Austen Shaft was excavated in 1926; however, the majority of development was focused on a belt of quartz veins in greywacke and slates that was approximately 23 m wide where intersected from the Austen Shaft. Approximately 967 ounces of gold production is recorded for Beaver Dam between 1889 and 1941. From 1978 until 1988, several companies drilled a combined 251 diamond drill holes for 47,935 m. Some of these drill holes were completed underground via an exploration decline that reached a maximum depth of 100 m below surface. In 1987, a small open pit was also excavated in the Austen Shaft zone. Approximately 2,445 ounces of gold production was also recorded for Beaver Dam between 1986 and 1989. Between 2005 and 2009 two companies drilled a combined 153 diamond drill holes for 22,010 m and also completed several other exploration programs including an aeromagnetic survey, a till survey, and a follow-up reverse circulation drilling program for geochemical purposes. Atlantic Gold secured the mine site in 2014 and immediately executed an exploration program whereby 38 diamond drill holes for 7,810 m were completed over the proposed surface mine area with the goal of converting inferred resources to measured or indicated resources.

The mine site is held under a single mineral exploration license (EL50421) currently owned by Annapolis Properties Corporation (Annapolis Properties), a whole owned subsidiary of Acadian Mining Corporation (Acadian Mining) which in turn is wholly owned by Atlantic Gold. EL50421 is comprised of 76 contiguous claims which cover an area of approximately 1,200 ha. Atlantic Gold owned companies (DDV Gold Ltd. and Annapolis Properties) also own five other exploration licenses adjacent to the Beaver Dam property (EL05927, EL07295, EL10407, EL50544, and EL08220). Figure 2.1-3 displays the approximate extent of EL50421.

The provincial abandoned mine openings (AMO) database records 20 AMOs in the area near the proposed Project area. Of these openings, 18 will be consumed by the proposed surface mine. The openings consist of shafts, pits, and raises that have had various forms of safety protection afforded to them over the years. Some openings are still considered hazardous. Historical openings are depicted on Figure 2.1-4, Existing Mine Conditions and on Figure 2.1-5, Abandoned Mine Workings.

The area is zoned mixed use under the Musquodoboit Valley and Dutch Settlement Land Use By-law. Extractive facilities, of which mining related infrastructure is one, are permitted within this zoning designation. The physical activity of mining or extraction is not specified in the by-law as it is governed in the provincial and federal regulatory regime (pers. comm. L. Walsh 2016).

The Beaver Dam mine site is located approximately five km north of the nearest residence which is located within the boundaries of the Beaver Lake IR 17.

2.1.2 Haul Road for Transporting Ore

The haul road will be developed on land owned by Northern Timber, the Nova Scotia Department of Natural Resources (NSDNR), and other private enterprises and residents. The general course of the haul road already exists; however deviations that result in new road construction to fulfill safe design standards will encroach on Crown and private land. Portions that require upgrades only will follow the general course of the existing haul road and may encroach on Crown and private land as well. The portion requiring new construction through a “greenfield” environment will be done so on land owned by Northern Timber and NSDNR. No residences are known along haul road sections requiring upgrades, with the exception of two seasonal cottages, one near the intersection of Beaver Dam Mines Road and Hwy 224 and one near the intersection of the haul road and the Mooseland Road.

Beaver Lake IR 17, located approximately 3 km west of the haul road at its nearest point hosts five permanent homes and four seasonal cottages. It abuts Hwy 224, which currently experiences considerable heavy truck traffic from forestry and other resource operations in the region. Other residences are located along Hwy 224 in the area but outside the boundaries of the IR. Figure 2.1-2 displays these residences, along with the boundaries of the IR, and their proximity to the haul road.

The area is zoned mixed use under the Musquodoboit Valley and Dutch Settlement Land Use By-law, and rural resource under the Eastern Shore (East) Land Use By-law. Haul roads are not specified in either by-law as these are governed in the provincial regulatory regime (pers. comm. L. Walsh 2016).

2.1.3 Touquoy Processing and Tailings Management Facility

The Touquoy processing and tailings management facility is an approved facility that is currently being constructed as part of the Touquoy Project in Moose River Gold Mines, Halifax County, Nova Scotia. It is being developed on land owned by Atlantic Gold and NSDNR, and centered at 504599 E and 4981255 N (UTM Zone 20 NAD 83 CSRS). Access to Crown land for the construction of the Touquoy Project has been granted through a Crown Land Lease Agreement with NSDNR (Lease No. 2794371 and Petition No. 37668).

The area, currently being developed for the Touquoy Project (2017), is zoned mixed use under the Musquodoboit Valley and Dutch Settlement Land Use By-law. Processing of ore and the management of tailings, which will be undertaken as part of the Beaver Dam Mine Project, is not specified in the by-law as these activities are governed in the provincial and federal regulatory regime (pers. comm. L. Walsh 2016).

Camp Kidston, which operates only in the summer months, is located 3.5 km northeast of the site. According to the Proponent, the nearest permanent full-time occupied residences are located approximately 5.8 km to the north of the open pit along Caribou Road. The next closest permanent residences to the Touquoy processing and tailings management facility are approximately 7.4 km to the northwest and 11.7 km to the southeast.

2.1.4 Ecological Setting

The Beaver Dam mine site is located in an area is described as having low topographic relief with average elevations of approximately 140 masl and scattered drumlins reaching approximately 165 to 175 masl. Much of the terrain in the PA consists of a patchwork of mature, immature, regenerating and disturbed tree stands of mixed wood forest, wetlands, and vegetation.

There are four mapped waterbodies located within the mine footprint PA. Crusher Lake is located in the western section of the PA, Mud Lake is located in the northwestern corner, and Cameron Flowage is located within the northeast corner, near the location of the proposed open pit. The fourth mapped waterbody (unnamed) is located in the southwest corner of the PA. Five mapped watercourses are located within the mine footprint PA.

Within the haul road footprint, there are sixteen (16) mapped linear watercourses, including two major rivers: West River Sheet Harbour River and Morgan River. Five small mapped waterbodies are documented along the haul road footprint just west of Lake Alma. During field assessments, however, these small waterbodies were confirmed to be wetland habitat.

There are several watercourses in the vicinity of the Touquoy site. Moose River is the largest watercourse adjacent to the property and flows along the western border of the mine site. An unnamed tributary to the Moose River flows south through the property, between the open pit and tailing management area. A first order unnamed tributary to the latter tributary starts south of the proposed pit and flows southward. Scraggy Lake is located to the south of the property and will be a water supply source for the Touquoy site. Fish River drains Square Lake to Scraggy Lake and both lakes are part of the Fish River Watershed that flows west and then south into Lake Charlotte, eventually emptying into Ship Harbour.

Overall, current and historic land use throughout the PA has resulted in a patchwork of mature, immature, regenerating and disturbed forest stands. The PA contains a diversity of habitat types and landscape features, but has experienced a considerable amount of disturbance and habitat fragmentation as a result of historic mine operations, and current and historic timber harvesting practices. Generally speaking, uplands within the PA contain immature or uneven-aged coniferous stands or mixed wood stands. Several pockets of mature coniferous forests are scattered throughout the PA but over mature stands were generally infrequent. Pure deciduous stands (including both tolerant and intolerant hardwood forests) are infrequent within the mine footprint PA, though they do occur occasionally within the haul road PA.

Significant Habitats are identified as:

- Mainland Moose Concentration Area (entire Project Area);
- Deer wintering Areas (9 km west of Beaver Dam mine);
- Areas with Species of Concern (5.2 east of Beaver Dam mine; 3.2 km and 8.9 km northeast of Touquoy; south and adjacent to Touquoy;

Provincial and national databases indicate the following protected areas within 10 km of the proposed Project:

- Nature Reserves

- Tait Lake (1.6 km north of mine);

- Wilderness Areas
  - Tangier Grand Lake (2.2 km south of intersection of Cross Road and Mooseland Road);
  - Twelve Mile Stream (4 parcels – closest is 5.2 km east of Mine site);
  - Ship Harbour Long Lake (west and adjacent to Mooseland Rd, south of Touquoy mine);
- Natural Water Supply Area
  - Middle Musquodoboit (9 km north of Beaver Dam mine, 6.3 km north of Touquoy mine).
- Game Sanctuary
  - Liscomb (no restrictions to mining – 7.3 km east of site)

2.2 Project Components

The Beaver Dam Mine Project will operate as a satellite surface mine with an approximate ore extraction rate of 2 million t/y. Ore produced at Beaver Dam will be crushed on site, loaded onto trucks, and transported along a haul road for processing at an existing facility constructed as part of the Touquoy Project. Tailings will be disposed of in the exhausted Touquoy surface mine.

The primary components associated with the Beaver Dam Mine Project include the following:

- Beaver Dam mine site
  - surface mine for extracting ore and waste rock,
  - mine site roads,
  - waste material storage piles for waste rock, till, and topsoil,
  - run of mine (ROM), high grade, and low grade ore stockpiles,
  - crusher and operational facilities; and,
  - water management
- haul roads for transporting ore; and
- Touquoy processing and tailings management facility.

Figures 2.2-1 to 2.2-3 display the location of components at the Beaver Dam mine site, the haul road route, and the location of processing and tailings management facilities at Touquoy.

2.2.1 Beaver Dam Mine Site

2.2.1.1 Surface Mine

The primary feature of the Beaver Dam mine site will be a surface mine from which 46.9 million tonnes of ore and non-ore bearing waste rock will be removed. Figure 2.2-1 displays the development of the surface mine in two phases over the three year extraction period. Phase one targets the south portion of the deposit and will produce approximately 18 months' worth of mill feed. The surface mine will be advanced from the exit at 130 masl down to 45 masl. Phase two will develop the surface mine towards the north and east wall, and extend the bottom of pit below the first phase. Phase two will produce approximately 18 months' worth of mill feed and advance the surface mine from the exit at 130 masl to the new bottom at -45 masl (i.e. 45 metres below sea level). At completion, the surface mine will measure about 900 m along its east-west axis, about 300-450 m along its north-south axis, and have a depth of approximately 170 m based on the current delineation of ore. The total area comprising the surface mine will be approximately 30 ha.

Clearing, grubbing, grading, and stockpiling of vegetation, topsoil, and till in the surface mine area will be conducted progressively prior to accessing host rock for mining purposes, to avoid erosion. All topsoil and till will be stored in stockpiles for use in reclamation and construction of berms, impoundments, mine site roads, and/or general site grading. Stockpile locations can be viewed on Figure 2.2-1. Once vegetation, topsoil, and till have been removed, drilling and blasting will be used to mine ore and non-ore bearing waste rock, as well as establish benches along rock walls.

Holes will be drilled into the host rock to receive explosives used for blasting. Previous exploration drilling has mapped the host rock for ore-bearing potential; therefore blasting patterns will be executed to maximize production of ore and minimize production of non-ore bearing waste rock. All blasting activities will be conducted by a licensed contractor.

On average, 35,480 tonnes of rock will be extracted from the surface mine per day. Of that, 5,480 tonnes will be ore-bearing and 30,000 tonnes will be waste rock. Ore and non-ore bearing waste rock will be loaded into off-highway haul trucks for transport out of the surface mine. From there, ore will be separated into low and high grade stockpiles prior to entering the crusher, while non-ore bearing waste rock will be stockpiled at its final disposal point.

2.2.1.2 Mine Site Roads

Mine site roads will be constructed to enable the mining fleet (loaders, dozers, trucks) to access topsoil and till stockpile locations. Mine site roads will also enable off-highway haul trucks to transport ore and non-ore bearing waste rock to stockpile locations. The ore haulage road will be dual lane and connect the surface mine exit with the ROM stockpile, crusher, and operational facility area. The waste haulage road will be dual lane and connect the surface mine exit with the topsoil, till, and non-ore bearing waste rock stockpiles. Both roads will have a gravel base and be 27 m wide, including berms and drainage, with a speed limit of maximum of 50 km/h. A pit perimeter road on top of the berm surrounding the surface mine will be a gravel base and be 12 m wide. The general location of the mine site roads is displayed on Figure 2.2-1.

2.2.1.3 Material Storage Piles

Material storage at the mine site will include two topsoil, two till, and one non-ore bearing waste rock stockpiles comprising a combined total of 92 ha. All of these locations will be cleared and grubbed concurrently with the surface mine area. The till and waste rock stockpile areas will also have topsoil removed and stored at the topsoil stockpile locations.

The two topsoil stockpiles will have capacities of 44 kilotonnes (kt) and 81 kt of material with final average grade elevations of 143 masl and 160 masl, respectively. The two till stockpiles will have capacities of 2,659 kt and 1,364 kt with final average grade elevations of 185 masl and 160 masl, respectively. Topsoil and till stockpiles will be stored in single lifts of 10 m and 15 m, respectively, with 1.5:1 and 2:1 active slopes, respectively.

The waste rock stockpile will have a capacity of 35,597 kt and a final peak grade elevation of 195 masl. It will be stored in multiple lifts of 10 m with each lift having an active slope of 2:1. A 20 m dual lane haul road running up the north side of the stockpile will provide progressive access to all lifts.

The general location of the waste material storage facilities is displayed on Figure 2.2-1.

2.2.1.4 Ore Stockpiles

The ore stockpiles (5 ha) will include low grade and high grade ore piles, located east of the crusher and operational facilities pad, and a ROM stockpile at the crusher.

The ROM stockpile will likely have up to a 30-day capacity for storing ore during plant shut-downs or short term periods where ore extraction from the mine exceeds crusher or plant capacity. The ROM stockpile can also accommodate plant feed if ore hauling from the mine is reduced for weather or other reasons.

The high grade ore stockpile will store ore with a gold grade above 0.50 grams per tonne (g/t). It will store ore mined during pre-production and during periods when extraction exceeds the capacity of the ROM stockpile. The low grade ore stockpile will store ore with a gold grade between 0.40 g/t and 0.50 g/t. It will be stored and re-handled through the crusher once the mine has been exhausted.

All ore stockpiles will be constructed in 15 m lifts with each having lift having an active slope of 1.5:1.

The general location of the ore stockpiles is displayed on Figure 2.2-1.

2.2.1.5 Operational Facilities

The following operational facilities (9.5 ha) at the mine site will be located in a central ROM and facilities pad that provides access to the haul road:

- crusher and conveyors;
- underground septic tanks and leach drains;
- raw water and potable water tank;
- diesel fuel storage and distribution system;
- skid-mounted diesel generators and power distribution overhead transmission lines;
- pole mounted lighting;
- vehicle washdown facility;
- pre-fabricated office facility and workshop building; and

- fire protection systems.

Figure 2.2-1 displays the general location of all the above ROM and facilities components.

A simple satellite primary crushing facility consisting of a grizzly feeder, jaw crusher, and primary crushed ore stockpile feed conveyor will be required for the Beaver Dam mine site. Used Touquoy equipment will be utilized where practical. However, a new ROM hopper will likely be installed at the Beaver Dam crusher.

Sewage from the Beaver Dam mine site office facility will flow by gravity drain via a piped network that will be buried below the frost line to septic tanks equipped with leach drains. No chemical waste will be disposed of through the septic system. The septic tanks will be pumped out as required by a contractor.

Raw water at the Beaver Dam mine site will be required for fire protection and other processing requirements. Sources of raw water include mine dewatering, surface water runoff, and raw water pumped from Cameron Flowage. Raw water drawn from Cameron Flowage will be pumped by a single duty submersible water pump to a combination raw water and firewater reserve storage tank. Two (duty and standby) centrifugal pumps will supply various users including, but not limited to, the vehicle wash down facility and the de-dusting crusher area locations. There is no requirement for decant water and potable water will be delivered via specialized truck. Raw and potable water storage will be in the operational facilities area. One (1) drilled domestic water well will provide water for sanitary use.

The diesel storage and distribution facility from Touquoy will be relocated to the Beaver Dam mine site, where practical, to fuel the mining fleet, generators, and haul trucks. Diesel will be delivered to the double-walled aboveground tanks via licensed tanker trucks and distributed to the mining fleet, generators, and haul trucks via a dedicated refueling truck. The facility will contain a low flow pump for light vehicles and a high flow pump for mine vehicles. The refueling truck will obtain fuel from this stationary pump system for delivery where required. Any spillage will be treated via the vehicle wash down facilities oil-water separation device. A small gasoline storage area may be included or may be satisfied by local retail outlets. The diesel fuel aboveground storage tank will be located on a concrete pad. It is anticipated that two 20,000 litre capacity diesel fuel storage tanks will be required, with final configuration to be determined based on final equipment selection.

The power demand required for the Beaver Dam mine site is insufficient to justify construction of a permanent electrical grid tie-in. As a result, two (duty and standby) self-contained, skid mounted, 500 kilowatt (kW) diesel powered generators will provide 600 volt (V) electrical power to all Beaver Dam surface consumers via 60 hertz (HZ), three phase, four wire overhead power lines. The generator fuel tank will receive diesel fuel from the dedicated refueling truck and has a one day capacity at maximum power demand.

Outdoor lighting for conveyors at the Beaver Dam mine site will be provided by 3 m pole-mounted high pressure sodium weatherproof lights, while 8 m pole-mounted floodlights will be utilized for the ROM and crushing area, as well as the remainder of the operational facilities pad.

A vehicle wash down facility likely consisting of manually directed water jets and a high pressure hot water and steam generator cleaner will be provided for the Beaver Dam mine site. Surface water runoff will be captured in a cleanout sump and processed via a triple interceptor oil trap and oil-water separation device.

A large administration building is not required for the Beaver Dam mine site. Instead, a temporary prefabricated facility equipped with office space, washroom facilities, a mine dry room, and a first aid facility will be provided. In addition, a workshop facility for general maintenance of the mining and haul truck fleet will be installed on a slab. The two prefabricated buildings will be located in the operational facilities area.

Adequate fire protection for the Beaver Dam mine site will be provided, and will likely consist of a truck(s) equipped with a water tank and pumps. All large equipment on the mine site will have fire suppression equipment. Supplementary hand held fire extinguishers, each suitable for its specific area, will be mounted in all buildings and vehicles. It is intended that firefighting activities will be handled by the local fire authority in Upper Musquodoboit and Sheet Harbour.

2.2.1.6 Water Management

Surface run-off water from the Beaver Dam mine site ROM and facilities pad will flow by gravity, with the aid of berms and channels, to a collection pond located between the crushing operation and water storage tanks. A culvert located beneath the mine entrance road will facilitate decant overflow from the pond to a water diversion structure that splits the two ore stockpiles. The water diversion structure will discharge to a channel that will run down gradient to the northeast and ultimately discharge to Cameron Flowage. The discharge point will be equipped with a concrete flow-control structure. The final design of the collection pond will be submitted as part of the Provincial Industrial Approval process. No reagents will be utilized at the Beaver Dam Site, with the exception of the flocculants, which will be available for use as required in the settling ponds.

Surface water run-off from the non-ore bearing waste rock stockpile, mine site roads, and till stockpiles will flow by gravity, with the aid of berms and channels, to a settling pond located west of the surface mine. This settling pond will also receive water from the surface mine dewatering program. Water will be gradually decanted to Cameron Flowage by gravity via a water diversion structure that runs northeast from the settling pond. The final design of the settling pond will be submitted as part of the IA process.

Minimal volumes of water will be re-used on Site for dust suppression purposes, as required. The majority of water collected in the settling pond will be released to Cameron Flowage. Reagents will be reviewed with the local NSE inspector for acceptability if anything other than water is determined to be required for dust suppression.

A berm surrounding the surface mine will direct surface water runoff into a water diversion channel that discharges to the settling pond to the west of the surface mine. The berm will be keyed into the bedrock to prevent shallow groundwater flow and/or surface water originating in Cameron Flowage from entering the surface mine. An in-mine water diversion ditch will be established along the top bench of the mine to intercept any surface water that infiltrates the berm and flows into the mine. This ditch will direct water to in-mine sumps where it will be pumped out of the mine.

Sub-horizontal drain holes will likely be established in the surface mine walls as they are exposed. On the active bench floor, the water that is collected from these drain holes will be directed to a sump where it can be pumped from the mine. Ditches will be constructed into mine benches to collect the water and direct it to a sump in an area where the bench is sufficiently wide. The water from subsequent sumps will be drained to the next bench below and collected into another sump. Generally, there will be a sump on the active pit floor. Drainage from the berms above will be down the pit ramp towards the sump. Vertical boreholes will likely be drilled at the mine crest and progressively on some benches as the mine is developed; piezometers will be installed to monitor groundwater levels as needed.

All water entering the mine will be handled by pumps installed in each active mine bottom as part of the flexible and moveable bench scale pumping system. The mine sump pumps will be connected to semi-permanent and permanent HDPE piping systems to convey water directly to the settling pond located west of the surface mine. The in-mine sumps will be installed with each box cut as the benching is advanced.

2.2.2 Haul Roads for Transporting Ore

As Beaver Dam will operate as a satellite surface mine, ore produced will require transport by road to the Touquoy Processing and Tailings Management Facility. Portions of the existing haul road (approximately 15.4 km) will require upgrading to a dual lane road (8 m) to facilitate the safe passage of two-way truck traffic at 70 km/h. Where upgrades will follow the course of the existing haul road, the width will be increased from approximately 4 m to 8 m, with an additional 3 m on either side to account for sloping and ditching. Where deviations from the existing course are required to fulfill safe design standards, new road construction (up to 14 m road and ditching) will occur. As a result, the daylighted corridor for the haul road will be a maximum of 14 m wide; however, the newly disturbed area may decrease where construction follows the course of the existing haul road.

A new section of road (approximately 4.0 km) constructed to the same design standards through a greenfield environment will also be required between the Beaver Dam Mines Road and the existing Moose River Cross Road. The alignment displayed in Figure 2.2-2 is based on preliminary engineering design. Final design will consider safety, social and environmental constraints to ensure the best case scenario for worker safety and environmental effects is developed. The new section of road is being construction to avoid travel on Hwy 224, through Beaver Lake IR 17. The alternate route as shown was presented in the stakeholder and Mi'kmaq engagement and is no longer being proposed based on feedback received.

The upgraded and newly constructed haul road will consist of a base of 300 millimetres (mm) of surge rock overlain by 300 mm of type 2 gravel and 150 mm of type 1 gravel. It is intended to use sized waste rock from the Touquoy Project as the surge rock base material and native till from the relict portions of the haul road to reduce the cost and disturbance of the road upgrading and new construction activity. Road construction will allow for a clear porous subgrade or cross drainage culverts in order for wetland hydrology to be maintained post-construction. Sources of suitably tested clear stone may include the Beaver Dam mine site, Touquoy mine site, the haul road corridor and/or local suppliers.

Three watercourses between 6 and 13 m wide are currently crossed via single lane timber bridges; these will be replaced by dual lane clear-span pre-engineered single arch modular bridges with an approximate lifespan of 30 years. Smaller watercourse crossings currently utilize culverts of varying sizes, makes, and conditions. Where the upgraded haul road follows the course of the existing haul road, culverts will be replaced by 600 mm corrugated steel culverts, each designed to extend 2 m beyond the edge of the haul road, where determined to be necessary. Where deviations from the existing course are required, culverts of the same design will be installed beneath the new span and culverts beneath the old span will be removed as necessary to facilitate the restoration of corresponding watercourses and to improve fish passage. Haul road grades will be designed to maintain a minimum cover of 1 m over all culverts.

The haul road will be upgraded where required to enable the safe and economic transportation of ore. Along the existing haul road at locations where the proposed road upgrade alignment will fall, it is anticipated that there could be up to 13 opportunities to improve fish habitat with new culvert installation and old culvert removed, up to 12 net zero scenarios where a new culvert could be installed, and 9 watercourses that will not be affected. Relict portions of the existing portions of the haul road that are not reclaimed during haul road construction will be properly reclaimed at the end of the Project lifespan, or returned to the original owner as per any future lease arrangements.

The haul road will be 30.7 km long. For the purposes of this description, it has been sectioned off as follows:

Section 1

- 7.2 km of unsealed two lane private road historically used for logging known as Beaver Dam Mines Road and owned by Northern Timber with varying quality from the Beaver Dam mine site to Hwy 224,
- the intersection between the Beaver Dam Mines Road, Hwy 224, and the new construction will be designed to meet Nova Scotia Transportation and Infrastructure Renewal (NSTIR) standards,
- the extent of required haul road upgrades and new construction will encroach on land owned by Northern Timber and NSDNR, and
- upgrades to this section of the haul road will also require replacement or new installation of up to 9 culverts, and upgrades to, or replacement of, single lane bridges with dual lane bridges across 2 watercourses. All upgrades will be made to government standards and permit requirements;

Section 2

- 4.0 km of new construction from the Beaver Dam Mines Road and Hwy 224 intersection to the Moose River Cross Road through a greenfield environment,
- the land required for new construction is owned by Northern Timber and NSDNR, and
- construction of the haul road will also require installation of one stream culvert. Others may be required to maintain flow in some wetlands. All installations will be made to NSE standards and permit requirements;

Section 3

- 8.2 km portion of the Moose River Cross Road that ends at the intersection with the Mooseland Road. This section is an unsealed single lane private road historically used for logging and owned by Northern Timber and others with varying road quality along its length,
- the intersection between the Moose River Cross Road and Mooseland Road will be designed to meet NSTIR standards,
- the extent of required haul road upgrades and new construction will encroach on land owned by Northern Timber, NSDNR, Musquodoboit Lumber Limited, Deepwood Estates Limited, Prest Bros Limited, and private residences, and
- upgrades to this section of the haul road will also require replacement or new installation of up to 10 culverts and upgrades to, or replacement of, a single lane bridge with a dual lane bridge across 1 watercourse. All upgrades will be made to NSE standards and permit requirements; and

Section 4

- 11.3 km of sealed and unsealed dual lane provincial local road known as Mooseland Road and owned by NSTIR suitable for heavy traffic from the Moose River Cross Road to the Touquoy Mine processing facility.
- Haul road upgrades will utilize existing road centre lines where possible to minimize encroachment on adjacent lands. Where encroachment on Crown land is unavoidable, lease agreements through NSDNR will be pursued. Similarly, where encroachment on private land is unavoidable, lease or purchase agreements will be pursued with the individual land owners. Leases will be in place prior to the beginning of any site work.

2.2.3 Touquoy Processing and Tailings Management Facility

Processing of ore from the Beaver Dam gold deposit at the existing Touquoy processing plant will begin upon completion of mining ore from the Touquoy deposit. The Beaver Dam Mine Project will utilize the processing facility at the Touquoy site to process Beaver Dam ore. Beaver Dam tailings will not be stored in the Touquoy tailings management facility, but instead will be permanently stored in the exhausted Touquoy pit after that deposit has been mined. This allows the Touquoy Gold Project footprint to be maintained as originally permitted and no tailings management will be needed at the Beaver Dam mine site. All other aspects of the Touquoy Gold Project will remain as assessed and approved through the Nova Scotia EA process in 2008.

Changes to the Touquoy Project as a result of the Beaver Dam Mine Project will be assessed through this EIS and include the following:

- an increase in the duration of ore processing (four additional years);
- minor alterations to the Touquoy processing facility to accommodate Beaver Dam ore; and
- disposal of tailings from Beaver Dam ore processing in the exhausted Touquoy mine.

The Touquoy Processing and Tailings Management Facility will be operational for an additional four years beyond the current lifespan anticipated for the Touquoy Project. This will result in four additional years of ore processing, water management, and tailings management and disposal. Ore extracted and hauled from the Beaver Dam mine site will be processed at the Touquoy processing facility once reserves at Touquoy have been exhausted. The Touquoy processing facility main building houses ball mill, gravity recovery, reagent make-up, elution, and refinery sections. The crushing, carbon in leach (CIL), and cyanide destruction sections are located outdoors. Tailings produced from processing Beaver Dam ore will be disposed of in the exhausted Touquoy open pit mine. Water from the deposited tailings will be recirculated through the processing facility in a closed loop. Make up water requirements will be sourced from Scraggy Lake or other sources as per NSE approvals. Figure 2.2-3 displays the location of these components.

The additional lifespan of the Touquoy site involves no new construction or disturbance (footprint) to the Touquoy facility or property. The Beaver Dam tailings will be managed in the exhausted Touquoy open pit mine. As originally planned in the approved Touquoy Gold Project Reclamation Plan, the inflow of groundwater, surface flow and precipitation into the pit will naturally create a lake upon closure of the site. Air emissions generated from the Touquoy site associated with the processing of Beaver Dam ore will be limited to emissions from the plant operation during processing. The primary potential effect of the continued use of the Touquoy facility on surface water and groundwater quality is the use of the exhausted open pit for tailings storage. It should be noted that data collected from the operations/extraction phase of the Touquoy operation for surface water and groundwater quality and quantity will be available to the AGC team. This will allow more refinement in the potential effect prediction for the Beaver Dam tailings deposition in the pit using over 7 years of data prior to the Beaver Dam tailings being introduced to the exhausted Touquoy pit.

Air, groundwater, and surface water quality and quantity will continue to be monitored over the life of the Touquoy site as part of existing approvals for approved life span of the facility and for the proposed extended life of the Touquoy site associated with processing of Beaver Dam ore. The tailings management facility and waste rock stockpile will continue to be monitored throughout the life of the Touquoy site as per the approved closure and reclamation plan for the Touquoy site; these facilities will not be used as part of the Beaver Dam Mine Project.

The additional lifespan of the Touquoy site could potentially affect the following VCs:

- Atmospheric environment;
- Surface water;
- Groundwater;
- Fish and Fish Habitat; and
- Migratory birds.

Air, noise, and light emissions generated due to the processing of Beaver Dam ore are anticipated to remain similar to those generated during the operation of the plant for the processing of Touquoy ore. Anticipated GHG emissions generated during the processing of Beaver Dam ore have been calculated based on the specific equipment that will be utilized during the processing of Beaver Dam ore. These effects are described in greater detail in Section 6.1.6.

Surface water quality will not be affected during the processing of Beaver Dam ore to the extent that it may be affected by the processing of Touquoy ore. Effluent from the Beaver Dam ore will not be discharged to Scraggy Lake, Moose River, or any other water body; therefore, anticipated effects on surface water due to processing activities during the Touquoy project, including effects on fish habitat and sediment, will not be applicable to the processing of Beaver Dam ore. In relation to the processing of Beaver Dam ore, surface water quality has been evaluated in terms of the quality of water in the shallow lake created in the Touquoy open pit mine only. Surface water quantity has also been evaluated in terms of surface water extraction required for the additional four years of processing required for Beaver Dam ore. These effects are described in greater detail in Section 6.3.6. The water quality in the open pit is not anticipated to effect nearby surface water quality in Moose River, thereby affecting fish and fish habitat. The open pit is physically disconnected from Moose River, and therefore the quality of water in the open pit is not anticipated to have any effect on the quality of other nearby surface water bodies. As noted above, surface water and groundwater quality and quantity data from the compliance program at Touquoy will be available to the AGC team. This will allow more refinement in the potential effect prediction for the Beaver Dam tailings deposition in the pit using over 7 years of data prior to the Beaver Dam tailings being introduced to the exhausted Touquoy pit.

Groundwater quality may be impacted as a result of the storage of Beaver Dam tailings in the exhausted Touquoy open pit mine. Groundwater quantity will not be affected by the processing of the Beaver Dam ore at the Touquoy facility. These potential effects are described in greater detail in Section 6.4.6. As noted above, surface water and groundwater quality and quantity data from the compliance program at Touquoy will be available to the AGC team. This will allow more refinement in the potential effects prediction for the Beaver Dam tailings deposition in the pit using over 7 years of data prior to the Beaver Dam tailings being introduced to the exhausted Touquoy pit.

Migratory birds may be indirectly impacted as a result of the surface water quality in the shallow lake created in the Touquoy open pit mine, if they were to land in the water. This is evaluated further in Section 6.9.6.

The continued operation of the Touquoy processing plant and the use of the open pit mine for tailings storage will also provide the potential for accidents and malfunctions to occur for an additional four years. This could potentially affect all VCs. There is no other interaction anticipated for other VCs, as noted in the individual effects assessments provided in Section 6.

2.2.3.1 Currently Approved Operations at the Touquoy Mine

The Touquoy Gold Project was described in a Provincial EARD and planned as a surface operation using drilling and blasting, with processing on site. Production is estimated at approximately 4,500 tonnes of ore per day with a total ore production estimate over the life of the mine of at least 9 million tonnes for recovery of almost 0.5 million ounces (oz.) of gold. Following the 12 month construction phase that is currently underway, the mine life is estimated to be five to seven years for processing of Touquoy ore, 3 to 4 years for processing of Beaver Dam ore based on favourable permitting, and two years for closure and decommissioning.

The open pit and associated infrastructure is centered on areas of previous (bulk sample in 1980's) and historic mining activity at Moose River Gold Mines. The Touquoy facilities include an open pit, processing plant, tailings storage facility, waste rock piles, power and water supply systems, offices, and a service support complex. The total area of the development at the Touquoy Gold Mine is approximately 265 ha. The open pit and mine site roads will occupy approximately 40 ha, processing plant and service complex will occupy approximately 60 ha, the tailings management facilities will occupy approximately 130 ha, and the waste rock storage pile will occupy approximately 35 ha.

Ore will be mined from the nearby Touquoy pit and delivered to the mill for processing. Processing will involve size reduction of the ore by crushing and grinding and recovery of the contained gold by mechanical and chemical processes. Recovery will entail gravity concentration, carbon-in-leach (CIL), elution and carbon regeneration, electro-winning and smelting, and cyanide destruction. Tailings and waste from ore processing of the Touquoy ore will be deposited in a storage facility and Beaver Dam tailings placed in the exhausted Touquoy pit as previously described in this EIS document. Water associated with the Touquoy tailings will be recycled for use in processing with the excess subject to treatment and released to the environment in accordance with existing regulations. At closure, all facilities will be removed, disturbed lands rehabilitated, and the property returned to otherwise functional use.

As part of the conceptual reclamation plan for the Touquoy site identified in the Provincial EARD, all site facilities will be removed, and the open pit will be allowed to fill with water forming a lake. Based on the existing water balance completed for the Touquoy facility, filling was anticipated to take about 20 years. The addition of the Beaver Dam tailings would greatly reduce the pit refilling time to be in the order of less than 10 years. The water in the pit will rise quickly in the initial years and slow as the pit widens.

The pit refilling and tailings deposition below the lake water level will immerse sulphide mineralization in the walls of the pit bottom eliminating potential for acid generation. If the quality of the pit water deteriorates relative to background levels, batch treatment with lime or ferric sulphate may be employed. The flooding of the open pit will create a lake approximately 15 ha in size with edge habitat. The existing mini-pit, excavated during the early 1990s to sample ore grade mineralization, serves as a model for the filling of the final open pit. The mini-pit provides a habitat for introduced trout which suggests that water quality will not be an issue when the open pit refills. It is noted that at the time of the Provincial EARD, water contained within the mini-pit, itself located within the proposed open pit, had a pH of 7.92 (non-acidic) and arsenic content of 0.032mg/L (well below MMER limit of 0.5mg/L). This suggests that natural water quality in the final pit after reclamation will probably be similar.

2.2.3.2 Touquoy Gold Mine Environmental Assessment

An Environmental Assessment Registration Document (EARD) was submitted for the Touquoy Gold Mine on March 15, 2007 As a result of the subsequent review, a Focus Report was requested by the Minister of Environment and Labour to provide additional details on certain specific aspects of the project. The nature of the Focus Report was detailed in the Terms of Reference (TOR) in a public letter to DDV Gold dated April 15, 2007. The Focus Report was submitted on November 19, 2007.

The EARD assessed the potential environmental effects of the Touquoy Gold Mine project on biophysical and socio-economic Valued Environmental Components (VECs). This assessment was based on inputs from members of the public, the Mi'kmaq community, government regulators and the professional judgement of the study team. The VECs identified for the Touquoy Gold Mine include:

- Air Quality;
- Noise;
- Surface Water Resources;
- Geology and Hydrogeology;
- Terrestrial Resources;
- Wetlands;
- Archaeological and Cultural Resources; and
- Population and Economy.

Species of special concern were also considered within each applicable VEC.

A review of the EARD and Focus Report identified that the following VECs were evaluated in terms of effects of the processing of ore during the Touquoy project: air quality, noise, surface water resources, and terrestrial resources. The remaining VECs were evaluated in terms of the effects of construction, mining operations, and use of the tailings management facility, and no additional effects were anticipated in the EARD or the Focus Report beyond the scope of these operations.

2.2.3.2.1 Air Quality

The predicted effects of processing of ore on air quality identified that intermittent emissions of propane exhaust, SO_2, and ammonia from the smelting furnace and electro-winning cells would be controlled using exhaust scrubbers, and that very low concentrations of any off-gases would be controlled to acceptable levels through the use of fans above the operations. Water vapour, CO, and CO_2 were anticipated to be less than the aggregate emissions from site vehicles. Process emissions were to be further characterized by dispersion modeling at the Industrial Approval phase. Based on additional studies and evaluation of collected data conducted as part of the Focus Report, minor air emissions will occur from the process plant, but contaminants are dispersed in the atmosphere to harmless concentrations immediately following release.

2.2.3.2.2 Noise

No significant effects on noise were anticipated to occur throughout the life of the Touquoy project. Based on studies conducted as part of the Focus Report, the maximum sound generated at the processing plant site is 80 dBA, which attenuates to the background of 40 dBA over a distance of 500 metres. There are no receptors besides site workers with appropriate safety gear including hearing protection within that radius.

2.2.3.2.3 Surface Water Quality

During the life of the Touquoy project, treated effluent from the tailings management facility will be discharged to Scraggy Lake. The effects of occasionally withdrawing water for the use in ore processing were identified as negligible. Water withdrawal will only occur on an as-needed basis.

2.2.3.2.4 Terrestrial Resources

Effects on terrestrial resources as a result of processing operations include the generation of air contaminants, which may in turn have an effect on lichens through air dispersion, and effects on fauna and birds due to chemicals used in the processing of ore. It was determined that the processing of ore was not anticipated to have significant adverse effects on rare lichens or fauna once mitigation measures have been applied, including appropriate reagent management. Dispersion modelling was anticipated to be completed for the Industrial Approval. Based on additional studies conducted as part of the Focus Report, airborne contaminants do not pose a health risk to flora or fauna on or off the Touquoy site. In the tailings management facility, contaminants such as cyanide and arsenic were anticipated to be below levels considered harmful to wildlife. The tailings management facility used for the storage of Touquoy tailings was not anticipated to have a significant impact on migratory or breeding birds should they land in the pond. The EARD also concluded that the tailings management pond would not be anticipated to have many characteristics considered attractive to birds, such as wading areas for foraging, limited benthic communities, and appropriate pH and nutrient levels.

On February 1, 2008, the Minister of Environment and Labour released the decision that the Touquoy Gold Mine project was approved.

2.2.3.3 Existing Industrial Approval at the Touquoy Site

An Industrial Approval (IA) was developed by NSE to add specific conditions for environmental management and monitoring associated with the construction, operation and reclamation phases of the Touquoy Gold Mine. The IA contains over one hundred specific requirements in 25 sections which include but are not limited to the following:

- Particulate emissions (dust) and sound levels;
- Blasting management and monitoring;
- Air emissions from plant operations;
- Groundwater and surface water management and monitoring;
- Liquid effluent discharge management and monitoring;
- Tailings management and requirement for an engineer of record for the tailings management facility;
- Management and containment of historic tailings;
- Management of waste rock and sampling procedures;
- Handling, storage and management of reagents;
- Contingency / emergency response plan;

- Environmental impairment liability insurance requirements;
- Complaint response procedures;
- Community liaison committee (CLC) facilitation;
- Reporting requirements; and
- Reclamation planning and posting of bond to ensure completed.

The IA has specific requirements at various project stages of the Touquoy Gold Mine. This included installation of 32 nested pairs of groundwater wells prior to construction and completion of four quarterly monitoring events prior to operation. This groundwater monitoring data as well as surface water monitoring data is now being collected at the Touquoy site and will provide a robust baseline data set with up to 7 years of data collected prior to use of the Touquoy site for the processing of Beaver Dam ore and management of associated tailings. The current compliance monitoring locations at the Touquoy site for groundwater and surface water are shown on Figure 2.2-4.

It is anticipated that many of the components of the Touquoy Gold Mine IA will be included in the future Beaver Dam Mine Project IA which will be developed by NSE prior to the Beaver Dam Mine Project commencing. As with other federal and provincial permits and approvals, these will be issued after the EA process is completed; typically the conditions and framing of follow up programs as part of EA approval are reflected as appropriate at the permitting level.

2.2.3.4 Ongoing Operations at Touquoy Facility and Benefits to the Beaver Dam Mine Project

Prior to the use of the Touquoy facility for the processing of Beaver Dam ore and storage of tailings in the exhausted open pit mine, approximately five years of operational data from the Touquoy operations will have been collected. This data will provide valuable insight into the potential effects of the Beaver Dam ore processing and tailings deposition in the expended pit. Monitoring on the Touquoy mine site and will include air and noise monitoring, surface water monitoring of nearby water bodies, and groundwater monitoring of an extensive network of near and far groundwater monitoring wells.. This ability to have actual data from an operational setting that is very similar to that proposed at Beaver Dam mine is unique and important. The two sites have similar geology, ore, mining methods, wetlands and surface water bodies in close proximity to the extraction areas. AGC will utilize this operational data to allow more refinement in the potential effect prediction for the Beaver Dam tailings deposition in the pit using over 7 years of data prior to the Beaver Dam tailings being introduced to the exhausted Touquoy pit.

Mining by nature is complex and necessitates the right use of personnel and equipment in creating an operation that is safe, benefits communities, and is done in a least harm manner to current and future natural settings. This operational expertise gained through the development and operation of the Touquoy Mine will be able to be applied at the Beaver Dam Mine as proposed. The primarily local workforce will be able to be used at the Beaver Dam facility as it is in the same general area (within 30 kilometres) and they will have over 5 years of additional operational experience beyond what they had prior to the Touquoy Mine being opened.

2.3 Project Activities

This section provides a description of activities to be carried out during each phase, information on the location of each activity, expected outputs and an indication of each activities magnitude and scale.

2.3.1 Site Preparation and Construction (Year 1)

2.3.1.1 Beaver Dam Mine Site

Site preparation at the Beaver Dam mine site will begin one year prior to operations commencing, with construction of key infrastructure following shortly thereafter. The following activities will be undertaken to prepare the Beaver Dam mine site for construction activities:

- clearing, grubbing, and grading;
- drilling and rock blasting;
- topsoil, till, and waste rock management; and
- existing settling pond dewatering.

Once site preparation activities have been completed, construction will commence and involve the following activities:

- watercourse and wetland alteration;
- mine site road construction;
- surface infrastructure installation and construction; and
- collection and settling pond construction.

The Beaver Dam mine site will have a total disturbed area of approximately 143 ha, consisting of the surface mine (30 ha); material storage (92 ha), including two topsoil, two till, and one non-ore bearing waste rock stockpile; operational facilities (9.5 ha); settling ponds and water diversion structures (2.3 ha); and mine site roads (4.5 ha). Ore stockpiles will comprise approximately 5 ha during operations but are not anticipated to remain at the completion of the Project.

Site Preparation

Clearing, grubbing, grading, and stockpiling of vegetation, topsoil, and till in the surface mine area will be conducted progressively prior to accessing host rock for mining purposes, to avoid erosion. All topsoil and till will be stored in stockpiles for use in reclamation and construction of berms, impoundments, mine site roads and/or general site grading. Vegetation clearing will be conducted in compliance with nesting bird directives from NSDNR and Environment and Climate Change Canada. Once vegetation, topsoil, and till have been removed, drilling and blasting will be used to mine ore and non-ore bearing waste rock, as well as establish benches along rock walls. Holes will be drilled into the host rock to receive explosives used for blasting. The pit will be mined down to the 110 bench (bench floor elevation). A berm surrounding the pit will be constructed to act as an access road and a flood berm.

Areas of material storage at the mine site will include two topsoil stockpiles, two till stockpiles, and a non-ore bearing waste rock stockpile. All of these locations will be cleared and grubbed concurrently with the surface mine area. The till and waste rock stockpile areas will also have topsoil removed and stored at the topsoil stockpile locations. The existing settling pond on the mine site has been identified as a wetland during the baseline studies (Wetland 59). Inflow into the wetland will be removed and the wetland will be dewatered in preparation for the open pit development. As discussed in Section 6.6, brook trout have been confirmed within this wetland and a fish rescue and relocation program is anticipated prior to the open pit development.

Site Construction

Mine site roads will be constructed to enable the mining fleet (loaders, dozers, trucks) to access topsoil and till stockpile locations. Mine site roads will also enable off-highway haul trucks to transport ore and non-ore bearing waste rock to stockpile locations. The ore haulage road will be dual lane and connect the surface mine exit with the ROM, crusher, and operational facility area. The waste haulage road will be dual lane and connect the surface mine exit with the topsoil, till, and non-ore bearing waste rock stockpiles. Both roads will have a gravel base and be approximately 27 m wide with a speed limit of maximum of 50 km/h. A road on top of the berm surrounding the surface mine will be gravel base and be approximately 12 m wide. Borrow materials for the construction of the mine roads will be sourced from the open pit during initial development and the processing areas. No other borrow pit areas are anticipated. The general location of the mine site roads is displayed on Figure 2.2-1.

Most mobile equipment and some support facilities will be transported from Touquoy to Beaver Dam for re-use. A simple satellite primary crushing facility consisting of a grizzly feeder, jaw crusher, and primary coarse ore stockpile feed conveyor will be required for the Beaver Dam mine site. The grizzly feeder and jaw crusher from the primary Touquoy crusher will be relocated to Beaver Dam once Touquoy ore is depleted. A new ROM hopper will also likely be installed at the Beaver Dam crusher. Where practical, the diesel storage and distribution facility from Touquoy will be relocated to the Beaver Dam mine site to fuel the mining fleet, generators, and haul trucks.

Outdoor lighting for conveyors at the Beaver Dam mine site will be provided by 3 m pole-mounted high pressure sodium weatherproof lights, while 8 m pole-mounted floodlights will be utilized for the ROM and crushing area, as well as the remainder of the operational facilities pad.

A temporary prefabricated facility equipped with office space, washroom facilities, a mine dry room, and a first aid facility will be provided. In addition, a workshop facility for general maintenance of the mining and haul truck fleet will be constructed.

A vehicle wash down facility likely consisting of manually directed water jets and a high pressure hot water and steam generator cleaner will be provided for the Beaver Dam mine site. Surface water runoff will be captured in a cleanout sump and processed via a triple interceptor oil trap and oil-water separation device.

Surface and ground water management facilities to include monitoring wells, ditches and berms will also be constructed during this period. A collection pond will be constructed between the crushing operation and water storage tanks to collect surface water run-on. A culvert will be constructed beneath the mine entrance road and will facilitate decant overflow from the pond to a water diversion structure that splits the two ore stockpiles. The water diversion structure will discharge to a channel that will run down gradient to the northeast and ultimately discharge to Cameron Flowage. The discharge point will be equipped with a concrete flow-control structure. A settling pond will be constructed west of the surface mine and will collect surface water run-off from the non-ore bearing waste rock stockpile, mine site roads, and till stockpiles. This settling pond will also receive water from the surface mine dewatering program. Water will be gradually decanted to Cameron Flowage by gravity via a water diversion structure that runs northeast from the settling pond. The final design of the collection and settling ponds will be submitted as part of the IA process.

A berm will be constructed surrounding the surface mine. The berm will be keyed into the bedrock to prevent shallow groundwater flow and/or surface water originating in Cameron Flowage from entering the surface mine. An in-mine water diversion ditch will be established along the top bench of the mine to intercept any surface water that infiltrates the berm and flows into the mine. This ditch will direct water to in-mine sumps where it will be pumped out of the mine.

Development of the mine site will cause direct and in-direct impacts to wetlands mostly within the construction phase of the Project. Direct impacts will be associated with clearing, grubbing, infilling and development of the mine and its associated infrastructure. Wetlands located within the mine site footprint are discussed further in Section 6.5.

Increased environmental disturbance is anticipated during initial site preparation, when drilling and blasting is being undertaken in the surface mine and clearing is being undertaken, and during the construction of stockpiles, berms, and surface mine roads.

2.3.1.2 Haul Road

Site preparation for the haul road will begin one year prior to operations commencing, with construction of key infrastructure following shortly thereafter. The following activities will be undertaken to prepare the haul road for construction activities:

- clearing, grubbing, and grading; and
- topsoil, till, and waste rock management.

Once site preparation activities have been completed, construction will commence and involve the following activities:

- watercourse and wetland alteration;
- culvert and bridge upgrades and construction; and
- haul road construction and upgrades.

Clearing and grubbing will be conducted prior to upgrading or construction of the haul road. Portions of the existing haul road (approximately 15.4 km) will require upgrading to a dual lane road (8 m wide) to facilitate the safe passage of two-way truck traffic at 70 km/h. Where upgrades will follow the course of the existing haul road, the width will be increased from approximately 4 m to 8 m. An additional 3 m on either side of the new road will account for sloping and ditching requirements. Where deviations from the existing course are required to fulfill safe design standards, new road construction (up to 14 m wide - road and ditching) will occur. New construction (approximately 4.0 km) built to the same design standards through a “greenfield” environment will also be required to avoid travel on Hwy 224, through Beaver Lake IR 17. The portions of the haul road that require upgrading are anticipated to include approximately 15.4 ha of disturbances. The new road construction through the “greenfield” environment is anticipated to include 5.6 ha of disturbance.

As a result, the daylighted corridor for the haul road will be a maximum of 14 m wide; however, the newly disturbed area may decrease where construction follows the course of the existing haul road.

The upgraded and newly constructed haul road will consist of a base of 300 millimetres (mm) of surge rock overlain by 300 mm of type 2 gravel and 150 mm of type 1 gravel. It is intended that sized waste rock from the Touquoy Project, as the surge rock base material, and native till from the relict portions of the haul road will be used to reduce the cost of construction and new disturbance. Construction materials will be brought in as needed and will not be stockpiled on the haul road. Road construction will allow for a clear porous subgrade or cross drainage culverts in order for wetland hydrology to be maintained post-construction. Sources of suitably tested clear stone may include the Beaver Dam mine site, Touquoy mine site, the haul road corridor and/or local suppliers.

Three watercourses between 6 and 13 m wide are currently crossed via single lane timber bridges; these will be replaced by dual lane clear-span pre-engineered single arch modular bridges with an approximate lifespan of 30 years. Smaller watercourse crossings currently utilize culverts of varying sizes, makes, and conditions. Where the upgraded haul road follows the course of the existing haul road, culverts will be replaced by 600 mm corrugated steel culverts, each designed to extend 2 m beyond the edge of the haul road. Where deviations from the existing course are required, culverts of the same design will be installed beneath the new span and culverts beneath the old span will be removed where appropriate to facilitate the restoration of corresponding watercourses and to improve fish passage. Haul road grades will be designed to maintain a minimum cover of 1 m over all culverts. Culverts will be installed in accordance with DFO and NSE guidance to reduce potential impacts to fish and fish habitat. Where appropriate, Atlantic Gold will work to install open bottom box culverts to reduce potential impact on the watercourses and associated fish habitat during road construction. Wetlands that are expected or confirmed to support fish habitat will be partially altered within the haul road PA to support road upgrades, widening and re-alignment as required.

The haul road will be upgraded where required to enable the safe and economic transportation of ore. Relict portions of the haul road may be properly reclaimed at the end of the Project lifespan, or returned to the original owner as per the lease arrangement. Re-vegetation will be encouraged on relict portions of the haul road, and opportunities will be explored to enhance wetlands and improve fish habitat, as discussed in Sections 6.5 and 6.6.

Speed limit and right-of-way signage will be installed and all haul truck operators will receive operator training to minimize the risk of collisions. All intersections will be designed to NSTIR Standards. Final design will consider safety and environmental constraints to ensure the best case scenario for worker safety and environmental effects is developed.

Increased environmental disturbance is anticipated during initial site preparation, construction of new portions of the haul road, and during the replacement/upgrades that will be completed to culverts and bridges.

2.3.1.3 Touquoy Processing and Tailings Management Facility

Minor works to modify the Touquoy processing and tailings management facility for Beaver Dam ore will begin before initiation of operation of the Beaver Dam surface mine. This transition phase will likely not exceed two months and the following activities will be undertaken to prepare the processing and tailings management facility to receive Beaver Dam ore:

- ore processing equipment upgrades; and
- tailings line alteration.

In order to accept Beaver Dam ore, a new vibrating feeder and new collection conveyor will be fitted to tie-in to the existing secondary feed conveyor between the Touquoy ROM hopper and secondary crusher. No changes will be made to the remainder of the processing facility.

Tailings from processing Beaver Dam ore will be disposed of by re-routing the tailings line exiting the back end of the processing facility from the Touquoy tailings management facility to the exhausted Touquoy mine. The reclaim water pump and barge, with a re-routed pipeline to the process water tank, will be relocated from the Touquoy tailings management facility to the exhausted Touquoy mine once production of Beaver Dam ore provides sufficient reclaim water accumulation from the tailings slurry. The TMF will not be used in the processing of Beaver Dam ore.

No additional land disturbances are anticipated to prepare the Touquoy facility to receive Beaver Dam ore.

Increased environmental disturbance is anticipated during the re-routing of the tailings line.

2.3.1.4 Existing Environmental Mitigation and Monitoring Requirements Associated with Construction

The construction activities at Touquoy site are minimal and within the existing Touquoy project footprint. The existing Touquoy IA well addresses construction activities, such as sediment and erosion control and spill protection and containment associated with construction equipment, e.g., fueling.

The existing environmental monitoring requirements at Touquoy include surface and groundwater monitoring as part of the IA. This will have occurred for about five years before construction activities associated with the Beaver Dam Mine Project commences. Also existing approvals for wetland alteration include requirements for monitoring and compensation; these will be completed during the life of the Touquoy Gold Mine and no additional disturbance of wetlands is required as part of the Beaver Dam Mine Project activities at Touquoy.

Project Schedule

During the one year construction phase, flexibility in the schedule may be employed to take advantage of seasonality. The upgrades to the Touquoy processing facility are not anticipated to exceed two months. This will likely be completed near the end of Year 1, after exhaustion of the Touquoy surface mine. Details regarding the time of year when activities will begin will be determined at a later date and discussed further during the IA process.

The Project Schedule will be discussed in more detail in Section 2.5.

2.3.2 Operation and Maintenance (Years 2 to 5)

2.3.2.1 Beaver Dam Mine Site

During operation and maintenance of the Beaver Dam mine site the following activities will be undertaken:

- surface mine operation and maintenance
    - drilling and rock blasting;
    - surface mine dewatering;
- ore management;
- waste rock management;
- surface water management;
- dust and noise management;
- petroleum products management; and
- site maintenance and repairs.

Surface Mine Operation and Maintenance

Once accessible, in-situ rock will be drilled and blasted on 5 m bench heights. Diesel powered rotary drills will be used for production drilling and horizontal high wall depressurization drilling on the ultimate pit walls. Blasting will occur at the same time of day once or twice a week. Dedicated reverse circulation grade control drilling and sampling will be used to define ore and waste rock limits, while a fleet management system will track each load transported from the surface mine.

Phase one targets the south portion of the deposit and will produce approximately 18 months' worth of mill feed. The surface mine will be advanced from the exit at 130 masl down to the pit floor at 45 masl. Phase two will develop the surface mine towards the north and east wall, and extend the pit floor below the first phase. Phase two will produce approximately 18 months' worth of mill feed and advance the surface mine from the exit at 130 masl to the new pit floor at -45 masl (i.e. 45 metres below sea level). At completion, the surface mine will measure about 900 m along its east-west axis, about 300-450 m along its north-south axis, and have a depth of approximately 170 m based on the current delineation of ore. The total area comprising the surface mine will be 30 ha. The ore production anticipated during the operation of the surface mine is discussed in greater detail in Section 2.5.

Blasting will be conducted using ammonium nitrate and fuel oil (ANFO) when blast holes are dry. A mixed emulsion type of explosive will be used when the blast holes are wet. Explosives and all accessories will be supplied on an as needed basis from a qualified contractor and be transported from a base location off-site and delivered to the blast holes using the contractor's equipment. As explosives will be supplied by an off-site contractor there is no requirement for an on-site magazine or associated permitting through NRCAN for this Project.

Diesel powered hydraulic excavators and a wheel loader will load both ore and waste rock into separate haul trucks. These loading units will also function to re-handle mine material, and load overburden and topsoil, as well as conduct mine clean up, road construction, and snow removal. The off-highway rigid frame haul trucks will have a 64 tonne capacity and haul ore to the ROM and facilities pad, while waste rock will be hauled to the waste rock stockpile. If dust is generated from hauling during warmer months, it will be controlled by applying water to the haul roads utilizing a specialized water truck. At the ROM pad, off-highway haul trucks will dump ore material directly into the primary crusher or place it in an active stockpile on the pad to be re-handled as crusher feed later on. Active stockpiles will be constructed in lifts as described in Section 2.4.1.4 of this EIS. Loading of stockpiled ore into the primary crusher will be accomplished via a diesel powered wheel loader. At the waste rock stockpile, haul trucks will dump waste rock and diesel powered track dozers will spread it into lifts as described in Section 2.4.1.3 of this EIS.

No reagents will be utilized at the Beaver Dam mine site, with the exception of flocculants, which will be available for use as required in the settling ponds.

The anticipated 246 person workforce at the Beaver Dam mine site will include approximately 105 mine personnel (working two or three shifts per day of 12 or 8 hours respectively, or approximately 26 persons per shift (includes 26 on leave at any time). The workforce also includes 60 haul truck drivers, 57 plant staff (at the Touquoy facility), and 24 general and administrative staff (between the Beaver Dam mine site and the Touquoy facility). An allowance of 10 days per year of no mine production has been assumed to allow for adverse weather conditions. No transportation to the mine site or on-site lodging will be required to be provided for employees.

A summary of the major mining equipment fleet requirements is provided in Table 2.3-1.

Table 2.3-1 Beaver Dam Primary Mining and Hauling Equipment Requirements

Activity and Equipment	Requirement				
	2022 (Partial year)	2023	2024	2025	2026 (Partial year)
Drilling					
Diesel DTH Tracked Drill, 110 mm holes	4	5	4	2	1
Diesel RC Tracked Drill, 135 mm holes	2	2	2	2	2
Loading					
Hydraulic Excavator – 4.55 m3 bucket	4	4	3	2	2
Wheel Loader – 7.0 m3 bucket	2	2	2	1	1
Hauling					
Haul Truck – 64 tonne payload	13	13	11	5	4

To facilitate successful mining operations, the following in situ support services will be available:

- mine site road maintenance;

- mine floor and ramp maintenance;
- ditching;
- reclamation and environmental controls;
- surface mine dewatering;
- surface mine lighting;
- mine safety and rescue;
- transportation of personnel and operating supplies; and,
- snow removal.

A summary of the equipment chosen to conduct these support services and their specific role is provided in Table 2.3-2.

Table 2.3-2 Beaver Dam Operational Equipment Requirements

Equipment	Function	Requirement
Motor Grader (4.3 m blade)	Mine site road maintenance	1
Water/Gravel Truck	Mine site road maintenance	1
Track Dozer (325 kW)	Waste rock stockpile maintenance	3
Water Pumps (150 m3/h)	Mine sump dewatering	2
Track Dozer (237 kW)	Mine support and construction	1
Wheel Loader (5.5 m3)	Mine support and construction	1
Hydraulic Excavator (2 m3)	Utility excavator and rock breaker	2
On-highway Dump Truck	Utility material movement	2
Fuel and Lube Truck	Mobile fuel/lube service	2
Shuttle Bus (16 passenger)	Employee transportation	1
Backhoe Loader (69 kW)	Utility loader and stemming loader	1
Pickup Trucks (1/4 tonne)	Staff transportation	7
Light Plants (20 kW)	Surface mine lighting	6
Skid Steer (54 kW)	Utility material movement	1
Track Dozer (149 kW)	Utility material movement	1
Maintenance Trucks	Mobile maintenance crew and tool transport	2
Mobile Crane (36 tonne capacity)	Mobile maintenance material handling	1
Float Trailer (55 tonne capacity)	Equipment transport	1
Forklift (3 tonne capacity)	Shop material and tire handling	1
Mobile steam cleaner	Mobile maintenance equipment cleaning	1

A majority of this equipment will be utilized during the site preparation and construction phase as well. Maintenance activities for the mobile mining, hauling, and operation equipment will be performed in the field and at the mine maintenance workshop facility located near the primary crusher. All field maintenance will be performed with dedicated maintenance equipment operated by qualified staff. A grader will be used to maintain the mine site roads. Snow clearing will be conducted regularly during the winter months. No salting of the roads will occur.

The Beaver Dam mine site may require a water source for fire protection and dust control. Sources of water include mine dewatering, surface water runoff, and raw water pumped from Cameron Flowage. Raw water drawn from Cameron Flowage will be pumped by a single duty submersible water pump to a combination raw water and firewater reserve storage tank located in the operational facilities area. Two (duty and standby) centrifugal pumps will supply various users including, but not limited to, the vehicle wash down facility and the de-dusting crusher area locations. Dust control will occur as required and will consist of wet suppression controls using only water on unpaved surfaces. There is no requirement for decant water and potable water will be delivered via specialized truck.

Daily sanitary water usage is based on approximately 30 employees on the mine site at any time. It is anticipated that one drilled domestic water well will be required to provide water for sanitary usage as domestic wells in this area generally yield 5 to 10 L/min based on a literature review of several sources and the demand is estimated at less than 5 L/min. The use of a storage tank on-site and water demand equipment will keep extraction rates within the well capability.

A vehicle wash down facility likely consisting of manually directed water jets and a high pressure hot water and steam generator cleaner will be utilized at the Beaver Dam mine site. Surface water runoff will be captured in a cleanout sump and processed via a triple interceptor oil trap and oil-water separation device. The wash down facility will be located in the central operational facilities area.

Sewage from the Beaver Dam mine site office facility will flow by gravity drain via a piped network buried below the frost line to septic tanks equipped with leach drains. No chemical waste will be disposed of through the septic system. The septic tanks will be pumped out as required by a contractor.

General non-mine waste will be collected by a contractor and transported off site for disposal.

Ore Management

On average, 35,480 tonnes of rock will be extracted from the surface mine per day. Of that, 5,480 tonnes will be ore-bearing and 30,000 tonnes will be waste rock. Ore and non-ore bearing waste rock will be loaded into off-highway haul trucks for transport out of the surface mine. From there, ore will be separated into low and high grade stockpiles prior to entering the crusher, while non-ore bearing waste rock will be stockpiled for final disposal.

The ore stockpiles (5 ha) will include low grade and high grade ore piles, located east of the crusher and operational facilities pad, and a ROM stockpile at the crusher. Acid rock drainage potential was analyzed and is discussed further in Section 6.2.3.4. Results indicated that the majority of the deposit is acid consuming; however there are areas that will require specific handling and disposal due to their sulphur content and acid generating potential.

The ROM stockpile will likely have up to a 30-day capacity for storing ore during plant shut-downs or short term periods where ore extraction from the mine exceeds crusher or plant capacity. The ROM stockpile can also accommodate plant feed if ore hauling from the mine is reduced for weather or other reasons.

The high grade ore stockpile will store ore with a gold grade above 0.50 grams per tonne (g/t). It will store ore mined during pre-production and during periods when extraction exceeds the capacity of the ROM stockpile. The low grade ore stockpile will store ore with a gold grade between 0.40 g/t and 0.50 g/t. It will be stored and re-handled through the crusher once the mine has been exhausted. Re-handling of the stockpiled ore will take place during Years 4 and 5 of operations.

Waste Rock Management

Material storage at the mine site will include two topsoil stockpiles, two till stockpiles, and a non-ore bearing waste rock stockpile comprising a total of 92 ha.

The waste rock stockpile will have a capacity of 35,597 kt and have a final peak grade elevation of 195 masl. It will be stored in multiple lifts of 10 m with each lift having an active slope of 2:1. A 20 m dual lane haul road running up the north side of the stockpile will provide progressive access to all lifts.

Surface Water Management

Surface run-off water from the Beaver Dam mine site ROM and facilities pad will flow by gravity, with the aid of berms and channels, to a collection pond located between the crushing operation and water storage tanks. A culvert located beneath the mine entrance road will facilitate decant overflow from the pond to a water diversion structure that splits the two ore stockpiles. The water diversion structure will discharge to a channel that will run down gradient to the northeast and ultimately discharge to Cameron Flowage. The discharge point will be equipped with a concrete flow-control structure.

Surface water run-off from the non-ore bearing waste rock stockpile, mine site roads, and till stockpiles will flow by gravity, with the aid of berms and channels, to a settling pond located west of the surface mine. This settling pond will also receive water from the surface mine dewatering program. Water will be gradually decanted to Cameron Flowage by gravity via a water diversion structure that runs northeast from the settling pond. The final design of the collection and settling ponds including the discharge points and proposed monitoring programs will be submitted as part of the IA process.

A berm surrounding the surface mine will direct surface water runoff into a water diversion channel that discharges to the settling pond to the west. An in-mine water diversion ditch will be established along the top bench of the mine to intercept any surface water that infiltrates the berm and flows into the mine. This ditch will direct water to in-mine sumps where it will be pumped out of the mine.

Sub-horizontal drain holes will likely be established in the surface mine walls as they are exposed. On the active bench floor, the water that is collected from these drain holes will be directed to a sump where it can be pumped from the mine. Ditches will be constructed into mine benches to collect the water and direct it to a sump in an area where the bench is sufficiently wide. The water from subsequent sumps will be drained to the next bench below and collected into another sump. Vertical boreholes will likely be drilled at the mine crest and progressively on some benches as the mine is developed; piezometers will be installed to monitor groundwater levels as needed.

All water entering the mine will be handled by pumps installed in each active mine bottom as part of the flexible and moveable bench scale pumping system. The mine sump pumps will be connected to semi-permanent and permanent HDPE piping systems to convey water directly to the settling pond located west of the surface mine. The in-mine sumps will be installed with each box cut as the benching is advanced.

Minimal volumes of water will be re-used on site for dust suppression purposes only, as required. The majority of water collected in the settling and collection ponds will be released to Cameron Flowage. The maximum anticipated water re-used on the mine site for dust control purposes is approximately 500 m^3 daily. However, this will occur on an as-needed basis only.

Between 1986 and 2014, several hydrogeological investigations were conducted on the mine site. Investigations included a pumping test conducted on the Austen Shaft, and packer tests conducted on single diamond boreholes. The geometric mean value of all of the hydraulic conductivity results from the 1986 and 2014 testing programs is 4.5×10^{-8} m/sec. Based on a review of the 2015 groundwater inflow assessment completed by Peter Clifton & Associates (2015), the estimated average groundwater inflow rate into the open pit at Beaver Dam from the till is 450 kL/day (5.2 L/sec) and groundwater seepage rates into the open pit at Beaver Dam from bedrock is between 100 kL/day (1.2 L/sec) and 1,000 kL/day (12 L/sec). Based on the results of this assessment, it can be assumed that between 550 kL/day and 1,450 kL/day of water will inflow into the open pit each day from the surrounding till and bedrock. The majority of this water will be required to be pumped from the mine. Direct input from precipitation to the pit will also be removed and directed in a similar manner to Cameron Flowage. The net result of changes to the flow regime in the pit area is nominal and flow gets directed to where it does currently i.e. Cameron Flowage.

Based on the estimated inflow rates into the open pit, approximately 550 to 1,450 kL/day will be required to be removed from the open pit each day by dewatering, and, along with surface water run-off, rainfall, and other sources of water from the Site, will be ultimately discharged into Cameron Flowage. Effluent flow is anticipated to be greater than 50 m^3/day; therefore, the MMER will apply to the mine site. The discharge of water will be monitored under a mandatory environmental effects monitoring (EEM) program prescribed by Environment and Climate Change Canada. The MMER has a prescriptive EEM program that all metal mines must follow. All discharge points to Cameron Flowage will be monitored for compliance with established regulatory criteria for water quality. Cameron Flowage will be subjected to extensive evaluations of fish health, sediment, and water quality to meet the MMER, and is discussed in more detail in Section 6.3.

Petroleum Products Management

Diesel fuel will be used in all mobile equipment and to power on-site generators throughout the operational phase of the Project. Other petroleum based and non-petroleum based liquids will be used for equipment maintenance. Propane is not currently anticipated to be utilized at Beaver Dam as buildings will be electrically heated by diesel-powered generators; however an economic assessment will be completed during the design phase to confirm the associated carbon footprint and costs for each heating fuel.

The delivery of diesel fuel will be conducted by tanker trucks from suppliers who routinely transport and distribute petroleum products. Transfer of these products from the tanker truck to double-walled tanks with bollards will be constantly supervised by the delivery person to ensure constant observation and immediate response should a spill occur. Based on anticipated equipment, associated efficiency ratings, and hours of operation, diesel fuel consumption by operational equipment and haul trucks has been estimated to be approximately 9.02 million litres of diesel fuel per year during full scale operations. During construction and decommissioning, diesel fuel consumption will be approximately 3.7 million litres per year.

Diesel fuel and lubricant storage will be located near the primary crusher and a dedicated fuel and lube truck will deliver these materials to the mine and maintenance mobile fleet, as well as diesel powered generators. Diesel fuel is required for the mining fleet and power generators for equipment at Beaver Dam. Diesel will be supplied from local sources by road tankers and stored in approved, double-walled tanks. From here, fuel will be distributed to equipment consumers by means of a dedicated fuel truck. The fleet of road trucks required to transport crushed ore from Beaver Dam to the process plant at Touquoy will be refueled at Beaver Dam as needed using the fuel truck noted above.

Where practical, the diesel storage and distribution facility from Touquoy will be relocated to the Beaver Dam mine site to fuel the mining fleet, generators, and haul trucks. Diesel will be delivered to the double-walled aboveground tanks via licensed tanker trucks and distributed to the mining fleet, generators, and haul trucks via a dedicated refueling truck. A standard stationary pump system will transfer diesel fuel from the tanks to the refueling truck. It is anticipated that two 20,000 litre capacity diesel fuel storage tanks will be required, with final configuration to be determined based on final equipment selection.

Increased environmental disturbance is anticipated during drilling and rock blasting, transportation of ore from the surface mine to the various stockpiles, maintenance activities, and at times of surface water discharge to Cameron Flowage.

2.3.2.2 Haul Road

During operation and maintenance of the haul road the following activities will be undertaken:

- ore transport; and
- haul road maintenance and repairs.

Ore Transport

Crushed ore from the Beaver Dam pit will be transported to the Touquoy process plant by truck travelling along upgraded existing roads. The route is Beaver Dam Mines Road to Hwy 224 to logging roads herein referred to as the Moose River Cross Road to Mooseland Road.

The Beaver Dam Mines Road (7.2 km) is an unsealed private logging road of varying quality. The 4.0 km section of newly constructed road will be an unsealed private road. The Moose River Cross Rd (8.2 km) is a private logging road of varying condition. The Mooseland Road (11.3 km) is a provincially owned road that has sealed and unsealed sections, suitable for heavy traffic. It is intended that the logging roads will be upgraded and widened to two lanes with improved alignments to provide better curves and gradients where necessary to achieve an operational design speed of approximately 70 km/h. Three bridges have been identified as requiring reconstruction and widening to achieve that condition with full passing safety. Culverts were investigated to determine the nature of the flow, which falls within three categories: Watercourse (potential for fish habitat); culvert (local drainage only); and, wetland drainage.

Approximately 20 highway trucks will be required to transport the ore from Beaver Dam to Touquoy. The exact number will depend on the hauling schedules, which will likely be a single 12 hour shift or two 8 hour shifts per day. This would mean approximately 60 individuals will be required to operate the highway transport fleet. The number of return truck trips per day will be an annual average of approximately 185 for 12 or 16 hours per day, 350 days per year for the anticipated duration of the mine Project (3.3 years). During construction and pre-production (8 months), the number of trips will be less and required for moving material from Touquoy to Beaver Dam and construction and upgrade of the haul roads.

Haul Road Maintenance and Repairs

All grading, gritting, snow clearing, and nominal maintenance conducted on the haul road will likely be completed by a third party contractor. An on-highway truck will be outfitted with a water tank and a gravel spreader. The water truck will spray the width of the haul roads to control dust, as required. The gravel spreader will be used during the winter months for traction control. Snow clearing will be completed regularly during the winter months. There will be no salt application conducted on the haul road.

Increased environmental disturbance is anticipated during peak transport times (12 to 16 hours per day) and during maintenance activities along the haul road.

2.3.2.3 Touquoy Processing and Tailings Management Facility

During operation and maintenance of the Touquoy processing and tailings management facility the following activities will be undertaken:

- ore processing; and
- tailings management.

Ore Processing

Other than the primary ore crushing, no mineral processing will be undertaken at Beaver Dam. All processing will be completed at the Touquoy facility after the ore from the Touquoy pit has been exhausted.

The Touquoy plant is designed to treat Beaver Dam ore with no modifications other than an increase in the total weight of grinding balls in the ball mill to accommodate the slightly harder ore from the Beaver Dam pit. This will not require any larger equipment.

Tailings Management

There is no requirement for tailings management at Beaver Dam as all mineral processing will be done at the Touquoy facility. Tailings generated from this operation will be pumped to the mined-out Touquoy pit for storage and covered with water to create a lake during reclamation. The approved Touquoy Environmental Assessment stated that the pit would be allowed to fill naturally with water over a period of time through precipitation, surface flow and groundwater in-flow. No change to this method is planned following the deposition of Beaver Dam tails, except that the time frame for refilling will be shorter given the decrease in available volume taken by the tailings.

Process water will be recycled from the Touquoy pit and from the Touquoy tailings management facility as required.

The Touquoy Pit is expected not to completely fill with water during the processing of Beaver Dam ore but if this does occur excess water will be pumped into the existing Touquoy tailings dam in order that it can pass through the waste water treatment system. Note that during operation of Touquoy, dewatering of the pit will occur with this water being directed to the TMF. As with Touquoy, it is expected that within two years of ceasing ore processing, the quality of water to be discharged will meet all provincial and federal standards without treatment. Preliminary test work has shown this to be the case, but more detailed geochemical test work will be completed as part of the Touquoy Gold Project. This will further inform the management plans for the Beaver Dam Mine Project.

Increased environmental disturbance is anticipated during primary ore crushing.

2.3.2.4 Existing Environmental Mitigation and Monitoring Requirements Associated with Operations

As discussed in Section 2.2.3.3, there is an existing IA for the Touquoy Gold Mine which has specific environmental mitigation and monitoring requirements. This is relevant to the Beaver Dam Mine Project in two ways:

- Monitoring data is being collected since 2016 and will continue to be collected through to the start of the Beaver Dam Mine Project as part of requirements under the existing IA. This provides much background data to support the follow up programs anticipated at the Touquoy site for the Beaver Dam Mine Project;
- Mitigation measures required as part of the IA and other associated Touquoy Gold Mine environmental management plans will continue to be implemented as part of the Beaver Dam Mine Project.

Given the operational activities at the Beaver Dam Mine Site are limited to processing of ore and management of tailings, existing mitigation and monitoring requirements applicable are directly related to atmospheric emissions, surface water and groundwater. These are summarized below:

Particulate emissions (dust):

- Six monitoring locations for dust have been identified near property boundaries which will be sampled during dry periods for total suspended particulate;
- Mitigation measures, such as application of dust suppressants during dry periods, will be implemented to control fugitive dust emissions; and
- Records of monitoring and any corrective actions will be submitted to NSE in the annual report; however, any non-compliance is identified to NSE in timely fashion as per the IA.

Air emissions from the plant operations:

- Emissions must be in compliance with Schedule A of the Air Quality Regulations and the IA specific requirements for maximum ground level concentrations at ground level / site boundary, as well as stack emission limits, e.g., total particulate matter and opacity;
- An air emission source program is in place to monitor emissions for compliance; if non-compliance occurs, an emissions reduction plan must be prepared and implemented to achieve compliance;
- Air emissions control systems are in place in accordance with the plans submitted to NSE prior to operations; this will be operated in accordance with the operation and maintenance manual, including regular inspections; and
- Records of monitoring and any corrective actions will be submitted to NSE in the annual report; however, any non-compliance is identified to NSE in timely fashion as per the IA.

Noise:

- Under the IA, maximum sound levels are prescribed at property boundaries for days, evenings and weekends;
- Monitoring is only required where requested by NSE, e.g., in response to a complaint or concern from a member of the public; and
- Mitigative measures will be implemented as necessary where sound levels are concern, i.e., causing annoyance, and monitoring demonstrates exceedances.

Groundwater:

- Thirty-two (32) groundwater monitoring stations are established in and around the facility; these are each nested well pairs with a shallow and deep well;
- Water levels in each well are measured monthly and water is sampled for chemical analysis each quarter for prescribed parameters, including metals, nutrients and other general water chemistry parameters;
- Around the open pit mine, data loggers are in place in these seven wells which record levels in the wells on an hourly basis at a minimum;
- Review of monitoring data is ongoing and compared with the approach as prescribed in the Groundwater Contingency Plan which includes a comparison of data with baseline levels and

accepted water quality guidelines, such as CCME Water Quality Guidelines for the Protection of Aquatic Life; and

- Records of water level, groundwater quality and any corrective actions will be submitted to NSE in the annual report; however, any non-compliance is identified to NSE in timely fashion as per the IA.

Surface water:

- Sixteen (16) surface water monitoring stations are established and monitored monthly for prescribed parameters, including metals, nutrients and other general water chemistry, like pH;
- These locations include natural watercourses both upstream and downstream of the facility, including Moose River, as well as the final facility effluent from the Touquoy TMF under the IA is also required under federal legislation, Metal Mining Effluent Regulations (MMER);
- Two permanent gauges in Moose River monitor flow both upstream and downstream of the facility;
- Surface water management and associated monitoring of the water drainage and collection is completed according to the plan submitted to NSE, such as volumes of tailings discharged to the TMF and water levels in the TMF;
- Water withdrawal from Scraggy Lake for plant operational requirements is monitored in terms of flowrate and water levels in the lake as per existing approvals; and
- Records of surface water balances, surface water monitoring and any corrective actions will be submitted to NSE in the annual report; however, any non-compliance is identified to NSE in timely fashion as per the IA.

Other mitigation measures are required as per the existing regulatory submissions and approvals for the Touquoy Gold Mine, including spill response plans and plans for handling and storage of plant processing reagents, including cyanide. The transportation, storage, handling, and treatment of cyanide is in accordance with the International Cyanide Management Code for the Manufacture, Transport, and Use of Cyanide in the Production of Gold. There are also procedures in place to respond to complaints and Terms of Reference of the function of the CLC.

It is anticipated that the future IA for Beaver Dam Mine Project will have similar requirements for mitigation and monitoring related to potential environmental effects of the Project activities. The collection of this data prior to operational activities relative to the Beaver Dam Mine Project provides additional baseline data (e.g., surface water and groundwater) and operational data (e.g., air emissions) that support the anticipated mitigation measures and follow up and monitoring programs.

Project Schedule

The surface mine operation phase is anticipated to be underway for approximately 4 years, beginning late in 2022 and being completed early in 2026, Pre-production will last approximately eight months, with full-scale operation lasting three years and four months. The Project Schedule will be discussed in more detail in Section 2.5.

2.3.3 Decommissioning and Reclamation (Years 5 to 7 and Beyond)

Preamble on Decommissioning

The purpose of site reclamation is to improve aesthetics and allow the site to return to its pre-development state or to a future planned use, while decreasing the potential for environmental risk.

Atlantic Gold will establish lease agreements with the province and private land owners for the life of the surface mine. Land leased for the Beaver Dam mine site, haul road, and Touquoy processing and tailings management facility will be returned to the province and private owners following the completion of operations, equipment decommissioning and removal, and the acceptance of decommissioning and reclamation activities by Nova Scotia Environment.

It should be noted that Atlantic Gold will not be the owner of any of the lands associated with the Project and therefore the final reclamation efforts will be largely determined by the land owners and through the lease agreements that will be established. Atlantic Gold recognizes the requirements for reclamation through the NS Environment Act and Mineral Resources Act and the role that NSE and NSDNR have in determining reclamation activities, bonds and plans. Atlantic Gold is well familiar with these requirements and agencies through the development of the Touquoy Mine and the development of the accepted Reclamation Plan and bond values for that mine. This knowledge and history is advantageous for the successful development of the Reclamation Plan for the Beaver Dam Mine that would be required at the Industrial Approval stage of the Beaver Dam Mine development.

Site Description at Closure

At closure, the Site will include the following:

- All mine site facilities will have been removed;
- The open pit will be allowed to fill with water to eventually form a lake with a wetland edge habitat;
- The waste rock pile will be capped with topsoil and re-seeded and all disturbed areas will be re-vegetated;
- The till stockpile will be re-vegetated if there are any residual materials following reclamation;
- Mine site roads will remain in place, and ultimately will be returned to the land owner for forestry and recreational use;
- The haul road will be returned to the land owners in an upgraded condition with habitat and wetland improvements;
- Fences will be removed once the majority of closure activities are completed;
- The Touquoy processing and tailings management facility will be reclaimed under a separate plan developed for the Touquoy Project and already approved by regulatory agencies.

Ultimately the land will be returned to conditions similar to its original state as a natural woodland and wetland habitat used for recreation and forestry. The existing conditions at the site have been previously described as being in a disturbed state in many areas and therefore improvements at the site will be realized through the reclamation activities proposed.

2.3.3.1 Reclamation Objectives and Goals

The objective of the Final Reclamation Plan is to return the site to a safe and stable condition, compatible with the surrounding landscape and anticipated final land use. The plan will employ recognized reclamation best practices, acknowledged principles of ecological restoration, and consultation with relevant stakeholders. In the past, the site has hosted numerous mining/exploration activities (exploration declines, roads, camps, settling ponds, and small waste piles of rock and overburden), along with successive tree harvesting and silviculture operations. Evidence of recreational land use (hunting and off-road vehicles) and surface water use (fishing and boating) at the site is limited and suggests these activities could be re-instated once the surface mine ceases operation and reclamation activities have been completed.

The goals of a successful Final Reclamation Plan include:

- remove all equipment and infrastructure not necessary for future use and care of the site;
- stabilize the terrestrial environment and revegetate the site to encourage regrowth of native species;
- minimize disruption to the aquatic environment; and
- restore land and surface water use potential.

The reclamation goals are designed to enable eventual abandonment of the site in a safe and stable state. In order to achieve these goals, Atlantic Gold will undertake general decommissioning and reclamation activities as described below.

2.3.3.2 Conceptual Reclamation Plan

Two of the three primary locations affected by the Beaver Dam Mine Project will be included in reclamation activities. The Touquoy processing and tailings management facility will be reclaimed under a separate plan developed for the Touquoy Project.

Reclamation Plan requirements in Nova Scotia include the need to submit a Conceptual Plan at the EA stage, a Reclamation Plan as part of the IA stage, and a Final Reclamation Plan six months prior to mine closure. The submission of a Conceptual Plan in concurrence with the EA allows the public, regulators, and Indigenous Peoples to provide comments Atlantic Gold can consider in the development of the Reclamation Plan. The Reclamation Plan will be used as the basis to determine the bond amounts and requirements at the Industrial Approval stage of the Project. The submission of a Final Reclamation Plan six months prior to surface mine closure will allow Atlantic Gold to incorporate knowledge of the site gained through site preparation and construction, and operation and maintenance. Public and Indigenous Peoples consultation and engagement will also be sought for the development of the Final Reclamation Plan through the Citizen Liaison Committee (CLC) as concerns raised during the development of the Reclamation Plan at the IA stage may have changed.

Surface Mine

The open pit surface mine will be allowed to flood. Based on the existing water balance, annual runoff depth for the site is 0.825 m/m^2. The surface mine and its immediate drainage area comprise about 50 ha, thus, approximately 410,000 m^3 of runoff will drain to the surface mine each year. Additional groundwater inputs will go to the Pit after dewatering pumps are removed at the end of mining. Given the volume of the surface mine is 9 M m^3, filling will take about 20 years. The reclamation plan submitted as part of an Industrial Approval process will detail information relative to Pit security measures for public and animal safety during the refilling period. These measures require the input of multiple agencies to meet regulatory and corporate requirements.

Water levels in the surface mine will rise quickly in the initial years following cessation of operations, but will slow as water reaches wider areas of the pit and a greater volume is required to increase water level. This will immerse sulphide mineralization in the walls of the surface mine eliminating potential for acid generation. If the quality of the water in the surface mine deteriorates relative to background levels, batch treatment with lime or ferric sulphate may be employed. Historic analysis of in situ ore and waste rock for ARD potential was completed in accordance with the Sulphide Bearing Material Disposal Regulations. Results indicated that the majority of the deposit is acid consuming; however there are areas that may require specific handling and disposal due to their sulphur content and acid generating potential.

Flooding of the surface mine will create a lake with a shallow water wetland border with an approximate area of 15 ha. The existing settling pond that was excavated during exploration activities during the 1980's serves as a model for this reclamation goal. The existing settling pond, referred to herein as Wetland 59, is hydrologically connected to Cameron Flowage via a watercourse equipped with an earthen and timber dam that controls discharge. The watercourse currently provides habitat for brook trout and small mouth bass, although only one individual small mouth bass was observed during the baseline studies. It is anticipated that Atlantic Salman may also be present and American Eel is likely present within the watercourse. These species are presumed to be present in the existing settling pond. The water discharging from the existing settling pond has an average pH of 6.71, which is considerably more neutral and suitable for fish habitat than downstream portions of Cameron Flowage with an average pH of 5.34. In addition, arsenic values in water discharging from the existing settling pond are well below the MMER limit. This suggests that water quality in the new lake will likely be similar.

Over the past 30 years, connectivity between the existing settling pond and Cameron Flowage has been intermittent. During operations of the mine, no direct connectivity between the pit and Cameron Flowage will be present. During decommissioning, the pit will be filled with water, creating a lake. The current plan does not include re-establishing a connection between this lake and Cameron Flowage. However, during permitting and also during the development of the reclamation plan, consultation with DFO will be completed to review this connectivity and the long term plan for the lake and Cameron Flowage.

Mine Site Roads and Haul Roads

The relocated public road will continue to serve as the main public thoroughfare after closure. The loose-surface, all weather roads established on the site to facilitate operations will remain in place to enable closure activities, monitoring, and provide access for commercial and recreational activities after closure is completed, and ultimately will be returned to the land owner.

The haul road will be returned to the land owners in an upgraded condition with habitat and wetland improvements. The majority of the lands proposed for the mining operation and infrastructure are majority owned by a commercial forestry operation (Northern Timber) with a minority of land along haul roads belonging to the Provincial Crown and other forestry companies. Relict portions of the haul road that were not reclaimed during construction will be improved by completing earthworks to encourage re-vegetation, placing windrow, and/or seeding with highway mix. Available local materials will be used for reclamation of the relict areas of the haul road.

Waste Material Storage Piles

The waste rock stockpile will be constructed with 2:1 active slopes in 10 m lifts proceeding from north to south. During mining, as a lift is completed, the slope will be pushed from 2:1 down to 2.6:1 or less to permit covering with soil and re-seeding. This approach will minimize the amount of exposed waste rock at any given time and reduce the potential for erosion and acid rock drainage (ARD).

Topsoil will be stockpiled in two locations during construction and used to facilitate re-vegetation at the end of the surface mine life and, when practical, during operation. All disturbed areas, most notably the waste rock and till storage piles, will be reclaimed with topsoil and growing medium to a depth matching the native surroundings. Re-vegetation will employ hardy pioneer species and grasses to colonize disturbed areas and stabilize soil. Native species will be planted to hasten a return to a natural ecosystem reflecting the pre-development site. Organic debris (roots, stumps, brush) will also be stockpiled and mulched to provide biomass for reclamation.

Ore Stockpiles

No ore stockpiles are expected to remain at the end of the surface mine life. The cutoff grade is 0.5 g/t and the current production plan calls for all material above cutoff grade to be milled. Atlantic Gold has hedged a portion of its production to ensure that any interim stockpiles that may exist can be processed profitably in the unlikely event that the mine closes early. If economics deem low grade ore to be unprofitable, then any remaining low grade ore stockpiles will be remediated or returned to the surface mine.

Operational Facilities

Buildings, equipment, and other infrastructure will be dismantled and salvaged or sold as scrap depending on condition and markets. Concrete foundations will be destroyed and buried. Minor excavations will be filled or barriers erected to eliminate hazard to the public or wildlife. Ancillary facilities (truck shop, fuel farm, generators) will be used to support reclamation activities for the surface mine and waste rock stockpile before final decommissioning. Fences will be removed once the majority of closure activities are completed.

If soil is encountered that is contaminated with hydrocarbons from the fuel farm and shop areas, it will be disposed of at an approved soil treatment facility. Dismantling procedures for all equipment and facilities will ensure that workers and the public are not exposed to hazardous materials or products used in or resulting from operations.

Water Management

All surface water runoff in the vicinity of the surface mine will be directed as dispersed flow into the surface mine to decrease filling time. The flooded surface mine will have shallow wetlands along its perimeter and will sustain wetlands downstream as well. Runoff from remaining waste rock and till stockpiles will be directed to settling ponds and/or the surface mine prior to release to the environment. It is expected that progressively capping and re-vegetating the waste rock pile will reduce erosion and limit the potential for ARD; therefore inhibiting the mobility of any potentially deleterious substances.

Increased environmental disturbance is anticipated during initial site decommissioning, when operational facilities are dismantled, and the site surfaces are re-vegetated. Increased environmental disturbances are not anticipated during post-reclamation monitoring.

Touquoy Processing and Tailings Management Facility

The Touquoy processing and tailings management facility will be reclaimed under the separate plan that was developed for and approved by regulatory agencies for the Touquoy Project.

The Touquoy Gold Project reclamation plan is developed, updated and finalized as required under the IA and requires approval of NSE in consultation with DNR. The reclamation plan for the Touquoy Gold Mine is secured by a bond posted by the Proponent totalling $10.2 million, which is intended to allow the Province to reclaim the site at all phases of the Touquoy Gold Mine. This plan includes allowing the pit to fill with water naturally from inflow of surface and ground waters and precipitation. Also required in the reclamation plan is ongoing monitoring post-closure to demonstrate stability of the site. This monitoring will cease in consultation with NSE once stability has been demonstrated by the monitoring data by comparing with baseline and operational data.

It is anticipated that the Beaver Dam Mine Project will have an IA with many similar components as the Touquoy Gold Mine IA; this will likely include a specific closure and reclamation plan associated with the Beaver Dam Mine Project and accompanying requirement to post a bond to ensure this work is completed. Similar to the Touquoy Gold Mine reclamation plan, environmental monitoring will be completed after closure until stability of the site and surrounding environs is demonstrated to regulatory authorities.

2.3.3.3 Reclamation Schedule

The estimated time line for decommissioning reclamation at Beaver Dam is as follows.

Table 2.3-3 Beaver Dam Reclamation Schedule

Reclamation Activity	No. of Years	Start Date	End Date
Construction	<1	2021	2022
Operations	3-4	2022	2026
Decommissioning (Mine & Haul Road)	0.5	2026	2027
Reclamation	1+	2026	2028
Monitoring	3	2027	2030+

2.3.4 Greenhouse Gas Emissions

Greenhouse Gas (GHG) emissions were considered for each phase of work for the life of the Project (construction, operation, and decommissioning) for the mine site and the haul road. The primary sources of emissions from each work phase are stationary and mobile fuel combustion sources. These fuel combustion GHG-specific emissions include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). During the operation phase of the Beaver Dam mine, rock blasting using explosives was also considered as part of the GHG emissions that would be generated. For rock blasting, the explosive considered in the assessment was ammonium nitrate with fuel oil (ANFO), which is an explosive used by Atlantic Gold at other project sites.

GHG emissions from Nova Scotia reported in 2014 were 16,600 kilotonnes CO2e (ECCC 2016b). Based on the Project GHG assessment, in an average full year of operation of the Beaver Dam mine (most GHG-intensive phase), including operation of the mine site, hauling of ore, and the processing of ore at the Touquoy facility, the Project facilities would emit 37.13 kilotonnes CO2e - approximately 0.22% of the reported 2014 GHG total for Nova Scotia. All operation, hauling, and processing for the life-of-Project would represent approximately 1.25% of the provincial one year total.

2.3.5 Summary of Changes to Project Activities

No changes have occurred to the Project Activities since the completion of the Project Description (GHD 2015), with the exception of the haul road alignment. The haul road alignment is also discussed in the Beaver Dam Mine Project Update (GHD 2016).

Two options were considered for a section of the haul road configuration. To determine the preferred option, the potential effects of the alternate haul road configuration on valued components were reviewed along with the outcome of stakeholder and Mi'kmaq engagement and the engineering feasibility review of the proposed alternate haul route, including estimated costs and practical engineering considerations.

The original haul road alignment utilized existing roads for transport of crushed ore from the Beaver Dam Mine to the Touquoy processing facility. The original haul road route included four sections of road, following the existing Beaver Dam Mines Road southwest to Hwy 224 (7.2 km); Hwy 224 northwest to the Moose River Cross Road (so called) (5.1 km); following the Moose River Cross Road southwest to the Mooseland Road (12.1 km); and then following the Mooseland Road northwest to the Touquoy Mine Site (11.3 km).

The total length of the original haul road configuration is 35.7 km. A portion of Route 224 is adjacent and provides access to Beaver Lake Indian Reserve 17 (Beaver Lake IR 17), a satellite community of the Millbrook First Nation.

The alternate haul road configuration proposes to utilize the same existing roads for transport of crushed ore from the Beaver Dam Mine to the processing facility at Touquoy, with the exception of the elimination of 5.1 km of Route 224 and 3.9 km of the Moose River Cross Road, and the addition of approximately 4.0 km of newly constructed road. The alternate haul road configuration includes four sections of road, following the existing Beaver Dam Mines Road southwest to Hwy 224 (7.2 km); crossing Hwy 224 to follow a newly constructed road through a greenfield environment (4.0

km); following the Moose River Cross Road southwest to the Mooseland Road (8.2 km); and then following the Mooseland Road northwest to the Touquoy Mine Site (11.3 km).

The total length of the alternate haul road configuration is 30.7 km. The new haul road alignment completely avoids travel on Hwy 224. Beaver Lake IR 17 is now located approximately 3 km west of the haul road at its nearest point; the original haul road alignment included travelling along Hwy 224, which abuts the Beaver Lake IR 17.

The new haul road alignment is approximately 5.0 km shorter in length than the original haul road alignment. This will result in a decrease in GHG emissions and dust generated by truck traffic during the life of the Project. The new haul road alignment allows truck traffic to avoid travelling directly through the Beaver Lake IR 17 and minimizes truck traffic on Hwy 224.

2.4 Accidents and Malfunctions

Accidents and malfunctions have the potential to occur through every phase of the Project. In order to decrease the likelihood of occurrence and level of magnitude should these accidents and malfunctions occur, Atlantic Gold will implement a preventative system approach to environmental protection, and worker health and safety. Contractors will be subject to the same health, safety, and environment policies and procedures, and all personnel (employees and contractors) will receive site specific training to prevent and mitigate workplace accidents and malfunctions. The health, safety, and environment policies and procedures implemented for the Touquoy Project will be extrapolated to the Beaver Dam Mine Project and made site specific where required.

Accidents and malfunctions that have the potential to occur through every phase of the Project are described in the follow subsections, while an analysis of the risks, a determination of their effects, and preliminary emergency response measures for these potential accidents and malfunctions is included in Section 6.15 of this EIS.

2.4.1 Structural Failures

2.4.1.1 Surface Mine Slope Failure

All phases of the Project have the potential for slope failures within the footprint of the surface mine. During the initial stages of site preparation and construction slope failures will be limited to overburden; however, as blasting, and ore and non-ore bearing waste rock extraction commences, bedrock faces have the potential to fail even when properly designed. Based on the current delineation of ore, the surface mine will be excavated through bedrock to an end depth of approximately 170 m below ground surface. Bench heights and bench face angles prescribed by a geotechnical study (O’Bryan et. al., 2015) will be implemented for specific depths and zones of the surface mine. A surface mine slope failure may result in fuel and/or other spills and/or injury or death to site workers.

2.4.1.2 Stockpile Slope Failure

All phases of the Project have the potential for slope failures in the topsoil, till, and waste rock stockpiles. Topsoil and till stockpiles will be stored in single lifts of 10 m and 15 m, respectively, with 1.5:1 active slopes. The waste rock stockpile will be stored in multiple lifts of 10 m with each lift having an active slope of 2:1. Ore stockpiles will be constructed in 15 m lifts with each lift having an active slope of 1.5:1. Slopes will be designed at an angle determined by geotechnical analysis and acceptable safety factors, thereby reducing the likelihood of a slope failure.

2.4.1.3 Settling Pond Failure

All phases of the Project have the potential for a settling pond failure. Surface water run-off from the non-ore bearing waste rock stockpile, mine site roads, topsoil stockpiles, and till stockpiles will flow by gravity, with the aid of berms and channels, to a settling pond located west of the surface mine. This settling pond will also receive water from the surface mine dewatering program. Water will be gradually decanted to Cameron Flowage by gravity via a water diversion structure that runs northeast from the settling pond.

The water diversion structure leading from the collection pond will discharge to a channel that will run down gradient to the northeast and ultimately discharge to Cameron Flowage. The discharge point will be equipped with a concrete flow-control structure.

In the event of a 1 in 100 year precipitation event, which in Nova Scotia is identified as approximately 115 mm in a 24 hour storm, a spillway into the water diversion structure will be used for overflow. In the case of a storm event or infrastructure failure, settling ponds will be monitored regularly.

2.4.1.4 Infrastructure Failure

Portions of all phases of the Project have the potential for infrastructure failure. Infrastructure at the Beaver Dam mine site will be minimal and given the short life of the Project, failure should not occur without being acted upon by extreme natural causes, such as a hurricane or earthquake, or human error.

2.4.2 Accidents

2.4.2.1 Fuel and/or Other Spills

All phases of the Project will involve the use of fuels, as well as equipment maintenance and servicing fluids. Generators and the majority of mobile equipment will utilize diesel fuel, which will be stored on-site in double-walled aboveground storage tanks. A small gasoline storage area may be included or may be satisfied by local retail outlets. Equipment maintenance and servicing fluids will include hydraulic oils, motor oils, greases, brake and steering fluids, antifreeze, and minor amounts of other maintenance fluids. The construction and operation phases will also utilize diesel fuel and ammonium nitrate as blasting agents. Ammonium nitrate will not be stored on-site.

The source of greatest risk for potential spills and releases of diesel fuel relates to the improper execution of procedures for transfer and handling to and from stationary and mobile tankage. Other sources of potential spills and releases of diesel fuel relate to equipment failures, damage to storage or piping systems, mobile equipment accidents, and mobile refueling truck accidents. Releases of maintenance fluids pose a lesser risk in terms of magnitude, but can still occur due to equipment failures, damage to storage containers, and mobile equipment accidents. A release of these fluids may result in soil, groundwater, and/or surface water contamination that may adversely affect ecological receptors through absorption, and/or ingestion of contaminated media.

2.4.2.2 Unplanned Explosive Events

An unplanned explosive event is limited to the site preparation and construction, and operation and maintenance phases of the Project. Explosives will be supplied by an off-site contractor and there will be no requirement for an on-site magazine.

2.4.2.3 Mobile Equipment Accident

All phases of the Project will have the potential for vehicular accidents to occur. Mobile equipment for the Project includes those outlined in Tables 2.3-1 and 2.3-2 of this EIS. The majority of mobile equipment traffic will be limited to the Beaver Dam mine site where guided traffic patterns, speed limits, right-of-way signage, and training will minimize the risk of vehicular accidents. The remaining mobile equipment will include haul trucks, which will travel from the Beaver Dam surface mine to the Touquoy processing and tailings management facility. The number of return truck trips per day will be an annual average of approximately 185 (370 one-way trips) or between 23 and 31 trucks per hour for 12 or 16 hours per day, 350 days per year for the duration of the mine Project (3.3 years). During construction and pre-production (8 months), the number of trips will be less. The haul road will be dual lane and designed to facilitate the safe passage of two-way truck traffic at 70 km/h. Speed limit and Right-of-way signage will be installed and all haul truck operators will receive operator training to minimize the risk of haul truck collisions. All intersections will be designed to NSTIR Standards. A mobile equipment accident may result in fuel and/or other spills, fires, and/or injury or death to site workers and the general public.

2.4.3 Other Malfunctions

2.4.3.1 Forest and/or Site Fires

All phases of the Project will have the potential for forest and/or site fires to occur. A forest fire may occur through human or natural causes, while a site fire may occur due to an equipment failure and/or human error. Forest fires have the potential to affect the Project at the mine site and at the processing and tailings management facility; however, due to a lack of vegetation at the mine site and processing and tailings management facility, it is unlikely that a site fire could spread to and affect the surrounding forest. Forest fires along the haul road have the potential to affect haul road operations and likewise, site fires along the haul road could spread to and affect the surrounding forest.

2.5 Project Schedule

Site preparation and construction for the Beaver Dam Mine Project will begin late in 2021 prior to exhaustion of the Touquoy surface mine so that the ore supply from the Beaver Dam surface mine to the Touquoy processing facility will follow shortly after the mining operations at Touquoy have ceased. Site preparation will begin following the end of the growing season (i.e. post-September 2021).

Year 1 (2021)

Clearing, grubbing, and removal of topsoil and till from the surface mine, till stockpile locations, and waste rock stockpile location, as well as removal of waste rock from the top benches of the surface mine by drilling and blasting will begin one year prior to relocation of the primary crusher from Touquoy. Clearing and grubbing will also occur during this time for the topsoil stockpile locations, the operational facilities location, and along the haul road. Vegetation clearing will be conducted in compliance with nesting bird directives from NSDNR and Environment and Climate Change Canada. Subsequently, stockpiles for topsoil and till will be built, and the initial lift of the waste rock stockpile will be constructed. Surface and ground water management facilities to include monitoring wells, ditches and berms will also be constructed during this period. The surface mine will be mined down to the 110 bench (bench floor elevation). A berm surrounding the pit will be constructed to act as an access road and a flood berm.

Haul road construction and upgrades between Beaver Dam and Touquoy will be completed in the year prior to Touquoy mine operations ceasing. It is anticipated that material used in the construction and upgrading of the haul roads will be waste rock supplied from the Touquoy site. Haul trucks that will be used in the transportation of ore from Beaver Dam to Touquoy will be acquired early and utilized to transport crushed rock from Touquoy to be used in construction and upgrades for the haul road. The use of this rock will be supported by appropriate geochemical and physical properties testing and data. Ongoing data collection at the Touquoy mine site during its current development will be used.

All other development work for the operational facilities construction and commissioning of the support infrastructure at Beaver dam will be completed in the six months prior to relocation of the primary crusher from Touquoy.

Local power supply infrastructure, installation of the fuel storage facility, and other supporting infrastructure will be linked to the start of early mining pre-strip operations. During the one year construction phase, flexibility in the schedule may be employed to take advantage of seasonality, etc.

After exhaustion of the Touquoy surface mine and before initiation of operation of the Beaver Dam surface mine, a transition phase not exceeding two months is expected, during which the primary crusher will be relocated from Touquoy and installed at Beaver Dam, the Touquoy processing facility will undergo minor alterations in preparation to receive Beaver Dam ore, and the tailings line will be re-routed to discharge wet tailings from Beaver Dam ore to the exhausted Touquoy mine.

Years 2 to 5 (2022 to 2026)

Operation of the Beaver Dam surface mine is planned to begin late in 2022 and continue through early 2026. Pre-production will last approximately eight months, with full-scale operation lasting three years and four months as outlined in Table 2.5-1.

The anticipated mining schedule will consist of 24 hours per day, while trucking will consist of 12 to 16 hours per day, and processing will consist of 24 hours per day.

Table 2.5-1 Beaver Dam Mine Project Production Schedule

Phase Mined (kt)	2022	2023	2024	2025	2026
Beaver Dam South Phase	9,529	9,705	2,341		
Beaver Dam North Pushback	4,606	6,789	9,439	4,116	406

Years 6 to 8 and Beyond (2026-2028+)

Decommissioning of the site will require approximately three to five years after cessation of operations. Two years will be needed to remove equipment and infrastructure, as well as complete re-grading and re-vegetation of the site, after which monitoring will continue until deemed no longer necessary. Monitoring typically continues for two to three years post-reclamation.

The general schedule for development of the MRC Project is provided in Table 2.5-2.

Table 2.5-2 Beaver Dam Construction, Operation, and Reclamation Schedule

Event	Timeline
Beaver Dam Construction	Q3/Q4 2021
Beaver Dam Operation	Q3/Q4 2022 to Q1/Q2 2026
Touquoy Partial Reclamation (waste rock stockpile and tailings management facility) and Environmental Monitoring	2023-2026+
Beaver Dam Reclamation and Environmental Monitoring	2026-2028+
Touquoy Complete Reclamation (processing facility, surface mine/beaver dam tailings management facility) and Environmental Monitoring	2026-2028+

A detailed anticipated schedule is provided in Table 2.5-3. It is emphasized that implementation of each activity is dependent on successful completion of the former. The schedule provided is considered to be preliminary and may be revised based on site conditions, permitting, or seasonality, etc.

Table 2.5-3 Preliminary Detailed Beaver Dam Construction, Operation, and Reclamation Schedule

Year	2017		2018				2019				2020				2021				2022				2023			
Quarter	Q3	Q4	Q1	Q2	Q3	Q4	Q2	Q2	Q2	Q2	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
ACTIVITY																										
Public Participation																										
Environmental Follow-Up Studies																										
Permitting																										
Site Preparation & Construction																										
Haul Road Construction																										
Touquoy Upgrades																										
Pre-Production																										
Commercial Production																										
Decommissioning & Reclamation																										
Compliance Monitoring																										

Table 2.5-3 Preliminary Detailed Beaver Dam Construction, Operation, and Reclamation Schedule

Year	2024				2025				2026				2027				2028				2029 and beyond (2-3 years)			
Quarter	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
ACTIVITY																								
Public Participation																								
Environmental Follow-Up Studies																								
Permitting																								
Site Preparation & Construction																								
Haul Road Construction																								
Touquoy Upgrades																								
Pre-Production																								
Commercial Production																								
Decommissioning & Reclamation																								
Compliance Monitoring																								

2.6 Alternative Means of Carrying out the Project

In accordance with Section 19(1)(g) of CEAA 2012, environmental assessments for designated projects must consider alternative means of carrying out the project that are technically and economically feasible, as well as the environmental effects of any such alternatives.

The process for consideration of alternative means is outlined in the CEAA Operational Policy Statement entitled "*Addressing "Purpose of" and "Alternative Means" under the Canadian Environmental Assessment Act, 2012*" and includes the following steps:

- Step 1 – identify technically and economically feasible alternative means;
- Step 2 – list their potential effects on valued components;
- Step 3 – select the approach for the analysis of alternative means; and
- Step 4 – assess the environmental effects of alternative means.

The evaluated alternative means of carrying out the Project are discussed following identification of alternative means. A summary of the assessment of alternative means is provided in Table 2.6-1 in Section 2.6.11 of this EIS.

2.6.1 Identification of Alternative Means

Alternative means of carrying out the Project are defined as means of similar technical character or methods that are functionally the same. Alternative means differ from alternatives in that they represent the various technical and economically-feasible ways that a project can be carried out, and which are within Atlantic Gold's scope and control.

As a minimum, the EIS Guidelines require Atlantic Gold to conduct an alternative means analysis for the following Project components:

- mine type;
- ore extraction methods;
- ore processing methods;
- ore processing locations;
- ore transportation;
- energy source;
- project component locations;
- water supply and management; and
- mine waste management facilities.

A qualitative approach primarily utilizing the professional knowledge and judgement of the EA Study Team has been employed for the assessment of alternative means and considers all four steps outlined in Section 2.6 of this EIS.

2.6.2 Mine Type

The potential alternatives to mining the Beaver Dam ore are through open pit (ramp access) and underground (shaft access) methods.

Open Pit Mining

Open pit mining requires the removal of overburden (topsoil, till) and non-ore bearing waste rock, followed by the stepped development of concentric levels into the deposit with an inclined roadway connecting subsequent levels. Open pit mining methods are best suited to:

- shallow ore deposits at or near surface that are covered by shallow overburden;
- large deposits with a uniformly distributed ore body or scattered randomly distrusted pockets; and
- high tonnage, low grade deposits which are not economical using underground mining methods.

Underground Mining

Underground mining typically requires the construction of a vertical, underground shaft from surface to a targeted depth into the ore body. Horizontal tunnels are then driven from the shaft at strategic intervals to access the ore body. Underground mining methods are best suited for:

- smaller ore bodies which are higher in grade; and
- disseminated ore bodies that easily traceable underground.

VCs Potentially Affected

The environmental effects of underground mining would be similar to those of open pit mining at Beaver Dam with the need for the infrastructure noted for the surface operation with a smaller disturbed footprint but likely a longer duration.

Preferred Approach

In this particular instance the gold at Beaver Dam is relatively uniformly distributed, and at relatively low grades, throughout the local rock mass to the extent that large scale, high volume throughput from an open pit is commercially viable. Concentrations of gold of sufficient grade, continuity or predictability in quartz veins, or other specific sites at Beaver Dam to support a commercially viable underground operation have not been identified through exploration and feasibility studies completed to date. An underground mine configuration for the Beaver Dam gold deposit is not currently a viable option.

Mining can theoretically be undertaken by either underground or open pit methods, but underground mining as a primary extraction method does not make practical or economic sense in this situation.

In this particular case, the resource is near surface. The proximity to surface and lower grade make it amenable to open pit methods. A continuation of the surface mining into an underground operation may be viable depending on the final depth of the deposit but this is currently not under consideration and would not be economic unless there was a dramatic increase in gold price.

2.6.3 Ore Extraction Methods

Drilling and Blasting

Drilling and blasting is proposed to extract ore at the Beaver Dam mine site. Drilling and blasting will generate noise; however the noise from drilling would be significantly less than that generated by rock breaking. Blasting will generate short duration noise less frequently.

Rock Breaking (Ripping)

Rock breaking, or ripping, involves the use of heavy equipment that scrapes the rock using hardened metal teeth or prongs. Rock breaking creates continuous significant noise. Due to the extremely hard nature of the ore in the vicinity of the mine site, rock breaking is not considered to be economically, technically, or environmentally feasible.

VCs Potentially Affected

The atmospheric environment is the key VC that would be affected by both drilling and blasting, and rock breaking (ripping); however, ripping would create significantly more noise over a continuous time period whereas drilling and blasting creates noise at lower levels and blasting occurs less frequently.

Preferred Approach

Drilling and blasting is the preferred approach for ore extraction from the Beaver Dam mine site. Alternative methods of extracting ore, such as rock breaking (ripping), are not technically or economically feasible due to the extremely hard nature of the ore in the vicinity of the mine site. There are no feasible alternatives to ore extraction at the Beaver Dam mine site.

2.6.4 Ore Processing Methods

Gravity/CIL Processing

The gravity/CIL processing methodology described in Section 2.3.1.3 of this EIS represents the most conventional processing option. It is the preferred processing option in Canada and is used worldwide in almost all major gold mining/processing operations. Two independent experienced consultant gold metallurgists have determined that gravity/CIL processing is extremely well suited to this particular ore in that gold recoveries are very high (about 95%) resulting in maximum use of the resource, and the cyanide destruction process is highly efficient (Ausenco 2015). Furthermore, gold doré is produced at the Touquoy facility, with minimal off-site value-adding.

Gravity/Flotation

Regardless of the above, a second processing option, gravity/flotation with either intense cyanidation or smelting of the flotation concentrate, has been explored. Gravity/flotation recoveries are also very high (about 95%), with the flotation concentrate comprising 4 to 5% of the total throughput. On the basis of expected daily throughput, about 200 tonnes of concentrate would be produced per day. The gold in the flotation concentrate may be recovered either by high intensity cyanidation or by off-site smelting.

High intensity cyanidation of the float concentrate will require at least the same quantity of sodium cyanide as conventional CIL (since the same amount of gold is available for dissolution) or possibly more. This multi-stage process is unorthodox, inherently more complex than conventional CIL processing and commercially unattractive with no perceived advantage.

This multi-stage process could potentially be undertaken off site with the concentrate transported to an existing CIL plant for contract treatment, the closest plants being in Quebec and Ontario. Enquiries have been made to eleven such operations with no availability offered. Indicative costs, including freight, determined from this exercise show this option to be commercially unattractive, with the added disadvantage of substantial off-site value-adding and reduced benefits to Nova Scotia.

The flotation concentrate could also potentially be transported elsewhere for smelting to recover the gold. Indicative costs for freight and contract treatment of the concentrate at Falconbridge's Horne smelter in Rouyn-Noranda have been obtained and these confirm this option to be commercially unviable, and again with substantial resultant off-site value-adding and reduced benefits to Nova Scotia.

VCs Potentially Affected

Environmental effects are generally similar in both alternatives. The same quantity of sodium cyanide is required in both alternatives, if not more for gravity/flotation. Smelting required during the flotation process would require transport to an off-site facility, thereby generating additional GHG emissions. The key VCs affected by the use of gravity/flotation processing would include the atmospheric environment.

Preferred Approach

Having carefully examined the above processing options Atlantic Gold has selected conventional gravity/CIL as its preferred processing methodology. The required equipment would be in place at Touquoy prior to the Beaver Dam operation beginning thus reducing infrastructure needs at Beaver Dam.

2.6.5 Ore Processing Locations

Touquoy Processing Facility

No new processing or tailings facility is planned for this site – ore will be trucked to Touquoy for milling and tailings will be deposited in the exhausted Touquoy pit. The Touquoy plant is designed to treat Beaver Dam ore with no modifications other than an increase in the total weight of grinding balls in the ball mill to accommodate the slightly harder ore from the Beaver Dam pit.

Beaver Dam Mine Site

If the economics of the Project change significantly such that this Project could be developed without Touquoy then a mill and a tailings storage plan for Beaver Dam would be required, which would involve a significant increase in the Project footprint. Alternatives to processing ore at the Touquoy site are cost prohibitive and environmentally inferior.

VCs Potentially Affected

Construction of an additional processing and tailings management facility would affect all VCs being considered in this EIS.

Preferred Approach

The preferred approach for ore processing locations is to utilize the Touquoy Processing and Tailings Management Facility for the milling of Beaver Dam ore, and depositing tailings in the exhausted Touquoy pit.

2.6.6 Ore Transportation

Off-site processing at Touquoy involves the transport of material via local roadways. This haul is an increase in the cost of production and will generate additional greenhouse gases from the highway truck fleet as compared to on-site processing. This will be at least partially offset by the significant environmental benefits of processing Beaver Dam ore at the Touquoy mill and the storage of tailings in the exhausted Touquoy pit. No other gold processing facilities exist within the economic trucking limit that can handle the planned volume of material. In addition, no new construction or expansion of the approved processing or tailings storage facilities at Touquoy to process Beaver Dam ore is required.

Alterative Haul Road Routes

Alternative haul road routes were considered to transport the Beaver Dam ore to Touquoy for processing. The original haul road route considered included approximately 5.1 km of travel along Hwy 224. The current haul road configuration includes a more direct route on the Moose River Cross Road. Specifically, the 3.7 km nearest Hwy 224 and the travel along Hwy 224 itself has been replaced with a direct route of 4.0 km of new construction which allows direct crossing of Hwy 224. This increases the travel along private logging roads and eliminates the travel along Hwy 224 completely as only a direct crossing is required. The total haul road is then reduced to 30.7 km.

It is intended to use sized waste rock from the Touquoy Project as the surge rock base material to reduce the cost and disturbance of the road upgrading and new construction activity.

VCs Potentially Affected

The key VCs affected by the alternative haul road location are the atmospheric environment, Indigenous populations, and socio-economic conditions due to additional noise and dust being generated along Hwy 224, near Beaver Lake IR 17.

Preferred Approach

The haul road route as currently planned is the preferred approach. The current haul road route for the Project reduces the total length and eliminates travel along Hwy 224, including the passing of Beaver Lake IR 17 which is a satellite community of Millbrook First Nation.

2.6.7 Energy Source

Diesel-Powered Generators

Two (duty and standby) self-contained, skid mounted, 500 kilowatt (kW) diesel powered generators will provide 600 volt (V) electrical power to all Beaver Dam surface consumers via 60 hertz (HZ), three phase, four wire overhead power lines. The generator fuel tank will receive diesel fuel from the dedicated refueling truck and has a one day capacity at maximum power demand.

Alternative Energy Sources

The power demand required for the Beaver Dam mine site is insufficient to justify construction of a permanent grid tie-in to the existing electrical distribution lines.

Renewable energy sources are considered technically feasible but would also not be economically feasible or practicable due to the short duration of the Project.

VCs Potentially Affected

The key VCs affected by the use of diesel-powered generators on the mine site include the atmospheric environment, surface water, wetlands, fish and fish habitat, and habitat and flora.

The key VCs affected by a permanent grid tie-in include the atmospheric environment, wetlands, habitat and flora, and terrestrial fauna due to disturbances caused by constructing a right-of-way for the power lines.

The environmental effects associated with a renewable energy source would depend on the renewable energy technology used; however, air emissions would likely be reduced.

Preferred Approach

The preferred approach based on economic and environmental feasibility is to provide electrical power to the Beaver Dam mine site through the use of diesel-powered generators.

2.6.8 Project Component Locations

There are no alternatives for the positioning of the open pit – the gold deposit is fixed and the open pit has been designed to envelope the existing settling pond (wetland 59). The settling pond that had been previously established on the Beaver Dam site will largely become part of the proposed open pit and thereby reclaimed. The Project components have also been placed to avoid heritage resources that have been identified during field investigations.

The waste rock stockpile has been positioned to be located down-gradient of nearby watercourses and waterbodies. The site configuration, including other Project components, has been specifically designed to avoid interference with aquatic habitat, and hence it is the preferred option to minimize environmental effects. Infrastructure has been placed to limit potential direct and indirect impact to Crusher Lake, Mud Lake and its associated watercourse (WC5) that drains from Crusher Lake to Mud Lake. Wetlands were avoided to the greatest extent possible for the placement of site infrastructure and the use of existing roads has been maximized in site layout planning as well.

VCs Potentially Affected

The key VCs affected by altering the Project component locations include wetlands, surface water, fish and fish habitat, and physical and cultural heritage resources.

Preferred Approach

The preferred approach is to maintain project component locations as shown on Figure 2.1-1. This limits the impacts to watercourses and avoids wetlands to the greatest extent possible.

2.6.9 Water Supply and Management

On-Site Water Supply and Management

Water use on the Beaver Dam mine site will be limited to water required for dust control, the vehicle wash down facility, fire protection, and domestic water usage. Sources of raw water include water collected during mine dewatering, surface water runoff from waste rock piles and constructed areas and, if needed, raw water pumped from Cameron Flowage. Raw water drawn from Cameron Flowage, if needed, would be pumped by a single duty submersible water pump to a combination raw water and firewater reserve storage tank. Two (duty and standby) centrifugal pumps will supply various users including, but not limited to, the vehicle wash down facility and the de-dusting crusher area locations. Potable water will be delivered via specialized truck to the site for use in facilities at the crusher area for personnel. It is anticipated that one drilled domestic water well will be required to provide water for sanitary usage as domestic wells in this area generally yield 5 to 10 L/min and the demand is estimated at less than 5 L/min. Dust control will occur as required and will consist of wet suppression controls on unpaved surfaces using only water.

Off-Site Water Supply

Alternatives for water supply, such as transporting all required water to the mine site were considered but the availability of adequate water for site operations (for site staff only and dust control) is a more reasonable approach, is economically sound and is technically feasible. One domestic water well will be required based on the demand anticipated and regional water resources studies confirm the low amount (less than 10 litres per minute) is easily available.

Surface Water Management

Surface run-off water from the Beaver Dam mine site ROM and facilities pad will flow by gravity, with the aid of berms and channels, to a collection pond located between the crushing operation and water storage tanks. A culvert located beneath the mine entrance road will facilitate decant overflow from the pond to a water diversion structure that splits the two ore stockpiles. The water diversion structure will discharge to a channel that will run down gradient to the northeast and ultimately discharge to Cameron Flowage. The discharge point will be equipped with a concrete flow-control structure. The final design of the collection pond will be submitted as part of the

Provincial Industrial Approval process. Surface water run-off from the non-ore bearing waste rock stockpile, mine site roads, and till stockpiles will flow by gravity, with the aid of berms and channels, to a settling pond located west of the surface mine. This settling pond will also receive water from the surface mine dewatering program. Water will be gradually decanted to Cameron Flowage by gravity via a water diversion structure that runs northeast from the settling pond. The majority of water collected in the settling pond will be released to Cameron Flowage. On-site control of water with batch discharges when water quality meets applicable standards is typical for this type of operation and the most technically and economically feasible.

No alternatives for water supply management were considered to be technically or environmentally feasible. Cameron Flowage is a valuable local and regional watercourse and direct discharge without settling and back-up ability for other treatment is not acceptable to Atlantic Gold.

VCs Potentially Affected

The key VCs affected by the water supply and surface water management approach that is planned includes

The key VCs affected by the transportation of potable water to the mine site include the atmospheric environment. If all required water were transported to the Site, a greater volume of emissions would be generated during the transport of water to the mine site.

Preferred Approach

On-site water collected from surface water run-off and pit dewatering will be used for dust control, the vehicle wash down facility, and fire protection. Domestic water requirements will be fulfilled by potable water delivery, and an on-site drilled well for sanitary usage.

2.6.10 Mine Waste Management Facilities

There will be no mine waste management facilities located on the Beaver Dam mine site, with the exception of the waste rock stockpile. The waste rock stockpile will have a capacity of 35,597 kt and have a final peak grade elevation of 195 masl. It will be stored in multiple lifts of 10 m with each lift having an active slope of 2:1. This approach will minimize the amount of exposed waste rock at any given time and reduce the potential for erosion and acid rock drainage (ARD). At reclamation, the waste rock stockpile will be reclaimed with topsoil and growing medium to a depth matching the native surroundings. Alternatives such as off-site transport or backfilling of the pit would result in emissions due to equipment use which is problematic and cost prohibitive for the overall Project viability. After final shaping and vegetating, the piles will mirror current local topography and landscapes.

There is no requirement for tailings management at Beaver Dam as all mineral processing will be done at the Touquoy facility. It is not considered economically or environmentally feasible for mine waste to be transported back to the Beaver Dam mine site following processing at the Touquoy facility.

VCs Potentially Affected

The key VC affected by transporting mine waste back to the Beaver Dam mine site is the atmospheric environment.

Preferred Approach

The preferred approach for mine waste management includes the on-site management of waste rock using the waste rock stockpile and to manage Beaver Dam tailings at the Touquoy facility.

2.6.11 The Preferred Approach

Based on the consideration of technical and economic feasibility, environmental effects, and socioeconomic effects, the preferred approach for the Project consists of:

- An open pit gold mine located on the Beaver Dam mine site;
- Ore extraction methods that employ drilling and blasting;
- Ore processing methods that employ gravity/CIL processing methodology which represents the most conventional processing option and is the preferred processing option in Canada;
- Processing Beaver Dam ore at the Touquoy processing facility once reserves at Touquoy have been exhausted;
- Transportation of ore from Beaver Dam to Touquoy for processing via a 30.7 km haul road, which will include upgrades to approximately 15.4 km of existing road and approximately 4.0km of new road construction through a greenfield environment;
- The use of two (duty and standby) self-contained, skid mounted, 500 kilowatt (kW) diesel powered generators to provide) electrical power to the Beaver Dam mine site;
- Project component locations as shown on Figure 2.1-1;
- On-Site water supply and management, with delivery of potable water; and
- No mine waste management facilities located on the Beaver Dam mine site.

A summary of the review of alternative means to carry out the Project is presented in Table 2.6-1 for each Project component of activity. This provides justification on the preferred approach for the Project relative to technical feasibility, economic feasibility and environmental and social effects. The VCs considered are noted as applicable under the environmental and social effects.

Table 2.6-1 Summary of Alternative Means of Undertaking the Project

Project Component or Activity	Alternative Means	Technical Feasibility	Economic Feasibility	Environmental Effects	Preferred Option
Mine Type	Surface Mine	Technically Feasible	Economically Feasible	Environmental effects are associated with the surface mine construction and operation; however, no significant residual environmental effects are anticipated for the Beaver Dam mine site.	Yes
	Underground Mine	Not Technically Feasible considering the configuration of the gold deposit.	Not Economically Feasible	Not assessed	No
Ore Extraction Methods	Blasting	Technically Feasible	Economically Feasible	Environmental effects include noise and dust impacts; however blasting will be conducted in shorter duration and will be controlled.	Yes
	Rock Breaking	Not Technically Feasible considering the hardness of the ore deposit	Not Economically Feasible based on the hardness of the ore deposit	Environmental effects include continual noise and dust impacts.	No
Ore Processing Methods	Gravity/CIL	Technically Feasible considering it is the preferred processing option in Canada and is used worldwide in almost all major gold	Economically Feasible	Environmental effects are generally similar in both alternatives: the same quantity of sodium cyanide is required in both	Yes

Table 2.6-1 Summary of Alternative Means of Undertaking the Project

Project Component or Activity	Alternative Means	Technical Feasibility	Economic Feasibility	Environmental Effects	Preferred Option
		mining/processing operations. Well suited to this particular ore		alternatives, if not more for gravity/flotation.	
	Gravity/Flotation	Not Technically Feasible based on an unorthodox complex multi-stage process for cyanidation or off-site smelting	Not Economically Feasible as it requires a complex multi-stage process or additional off-Site smelting.	Environmental effects are generally similar in both alternatives: the same quantity of sodium cyanide is required in both alternatives, if not more for gravity/flotation. Smelting would require transport to an off-site facility.	No
Ore Processing Locations	Touquoy	Technically Feasible as the Touquoy facility is already designed to treat Beaver Dam ore with minimal modifications.	Economically Feasible as the infrastructure for processing Beaver Dam ore is already in place. Haul road upgrades will need to be completed but are off-set by the benefits of using the existing processing facility.	Environmental effects for the Touquoy facility have previously been identified. Processing Beaver Dam ore at the Touquoy facility will result in an additional four years of processing beyond the current lifespan of the Touquoy Project and will result in an increase in the cost of production and greenhouse gas emissions due to	Yes

Table 2.6-1 Summary of Alternative Means of Undertaking the Project

Project Component or Activity	Alternative Means	Technical Feasibility	Economic Feasibility	Environmental Effects	Preferred Option
				transporting ore to Touquoy.	
	Beaver Dam	Technically Feasible	Not Economically Feasible as the infrastructure for processing Beaver Dam ore is already in place at the Touquoy facility.	Environmental effects of processing ore at the Beaver Dam mine site are greater in this scenario as a second processing facility and tailings management facility would be required to be constructed and operated. Construction of an additional processing and tailings management facility would affect all VCs being considered in this EIS.	No
Ore Transportation	Haul Road avoiding Hwy 224 via new construction	Technically Feasible	Economically Feasible	Environmental effects are similar for both alternatives. Construction of 4.0 km of new haul road will cause additional environmental effects than simply upgrading the haul roads; however the new road eliminates travel along Hwy 224 and the passing of	Yes

Table 2.6-1 Summary of Alternative Means of Undertaking the Project

Project Component or Activity	Alternative Means	Technical Feasibility	Economic Feasibility	Environmental Effects	Preferred Option
				Beaver Lake IR 17, which reduces potential effects on those residents.	
	Haul Road along Hwy 224	Technically Feasible	Economically Feasible	Environmental effects are similar for both alternatives. Travel along Hwy 224 through the Beaver Lake IR will cause noise and dust issues for residents due to the increased truck traffic.	No
Energy Source	On-site Generators	Technically Feasible	Economically Feasible	Environmental effects will include emissions associated with two diesel fuel-powered generators.	Yes
	Provincial Grid Tie-in	Technically Feasible	Not Economically Feasible as the current power demand is insufficient to justify the construction of a permanent grid tie-in.	Environmental effects would include construction of a right-of-way for electrical lines, including noise and emissions generated during construction and habitat and vegetation loss in the right-of-way.	No
	Renewable Energy Sources	Technically Feasible	Not Economically Feasible due to short duration of Project	Environmental effects would depend on renewable energy technology used;	No

Table 2.6-1 Summary of Alternative Means of Undertaking the Project

Project Component or Activity	Alternative Means	Technical Feasibility	Economic Feasibility	Environmental Effects	Preferred Option
				however, air emissions would be reduced	
Project Component Locations	As shown on Figure 2.2-1	Technically Feasible	Economically Feasible	Environmental effects will include loss of habitat; however this configuration avoids interference with aquatic habitats.	Yes
	Alternative Locations	Technically Feasible	Not Economically Feasible as this would require the reconfiguration of the components	Environmental effects would be similar in both scenarios; however, the alternative location of the waste rock stockpile could interfere with nearby aquatic habitat. Project components have also been positioned to avoid identified heritage resources.	No
Water Supply and Management	On-site water supply and management, with delivery of potable water	Technically Feasible	Economically Feasible	Environmental effects will include emissions associated with the transport of potable water to the mine site.	Yes
	Alternative sources of water	Technically Feasible	Not Economically Feasible to transport all water	Environmental effects would include a greater volume of	No

Table 2.6-1 Summary of Alternative Means of Undertaking the Project

Project Component or Activity	Alternative Means	Technical Feasibility	Economic Feasibility	Environmental Effects	Preferred Option
			requirements to the mine site.	emissions generated during the transport of all water to the mine site.	
Mine Waste Management Facilities	No on-site mine waste management facilities	Technically Feasible	Economically Feasible	Environmental effects for the Touquoy facility have previously been identified. Storing Beaver Dam mine waste at the Touquoy facility will result in the generation of mine waste after processing for an additional four years.	Yes
	On-Site mine waste management facilities	Technically Feasible	Not Economically Feasible to transport mine waste from Touquoy back to Beaver Dam after processing.	Environmental effects for transporting Beaver Dam mine waste from the Touquoy Processing facility back to Beaver Dam would result in the in an increase in the cost of production and GHG emissions.	No

3. Public Consultation and Engagement Program

3.1 Objectives

Atlantic Gold is committed to stakeholder consultation and engagement as part of its MRC Project. Using key values of openness, transparency, collaboration and respect, Atlantic Gold has continued to work with the local community, non-governmental organizations (NGOs), regulatory agencies, and interested members of the public for over a decade. As part of the planning and permitting of the Touquoy Gold Mine, the Proponent developed relationships with members of the local community and NGOs, such as the Moose River Gold Mine Museum Society. A Community Liaison Committee (CLC) has been in place since 2011.

Both federal and provincial EA legislation requires consultation with the public to recognize concerns about adverse effects of the environment and identification of steps taken by the proponent to address these concerns; therefore, these are specifically identified in the EIS related to Beaver Dam Mine Project. Beyond the regulatory requirements, Atlantic Gold strongly believes that meaningful engagement is crucial to the success of any development. The Proponent is committed to maintaining stakeholder consultation and engagement throughout the life of its MRC Project; these activities extend well beyond the EA process.

3.2 Engagement Strategy

A community engagement strategy has been developed by Atlantic Gold for the MRC Project. It sets out the formal engagement activities that Atlantic Gold will undertake throughout all phases of its exploration activities and mining operations in Nova Scotia. This includes the development, operation and reclamation of the MRC Project, which includes the permitted and under construction Touquoy Gold Mine and the proposed Beaver Dam Mine Project. Atlantic Gold will also seek to provide broader awareness to include advanced exploration activities at Cochrane Hill and Fifteen Mile Stream.

A successful community engagement strategy also provides flexibility to allow adaptation to the needs of the community. In 2016, Atlantic Gold developed its strategy for community engagement to coincide with the start of construction of the permitted Touquoy Gold Mine and the development of the EA for the Beaver Dam Mine Project. These elements listed below will be built upon over time as the MRC Project develops.

3.2.1 Community Liaison Committee

Community engagement is important to Atlantic Gold and the Community Liaison Committee (CLC) is its cornerstone. The CLC is diverse with representation from the surrounding communities; it was recently expanded to a nine-member CLC. The volunteer membership acts as an advisory board to Atlantic Gold. The CLC provides a mechanism for information exchange between communities and the company, as well as a forum to share questions, concerns, and input regarding the MRC Project. The CLC plans to meet quarterly with the potential for additional meetings depending on interest and Project developments.

The current members are: Charles Brown (Musquodoboit Harbour), Jennifer Copage (Sipekne'katik First Nation), Rick Deale (Middle Musquodoboit), Gilbert Fahie (Mooseland), Gerald Gloade (Millbrook First Nation), John Kennedy (Pleasant Harbour), Gary Leslie (Upper Musquodoboit), Marilyn Munroe (Sheet Harbour), and Barry Prest (Mooseland).

A draft Terms of Reference for the CLC was developed and will be finalized by the CLC early in 2017 (refer to **Appendix A**). The Terms of Reference sets out the governance for the CLC and defines its objective as an advisory body to Atlantic Gold with volunteer members representing local communities.

As defined in the draft Terms of Reference, guests may be invited to the CLC meetings where topics of interest are planned. This may include local community groups, like Eastern Shore Forestry Watch.

3.2.2 Open Houses and Town Hall Meetings

Open houses allow a developer to inform the general public about a proposed project, and conversely, interested members of the public have the opportunity to view information and speak directly with representatives of the proponent. This allows one-on-one discussions to answer questions of the visitor. For many members of the public, this can be a more comfortable form of communicating with the proponent than town hall type meetings.

The meetings can take many forms but usually involve information boards and displays showing the location of the proposed project in relation to nearby communities, fact and figures pertaining to the development, and an update of the general public on the status and progress of development activities, such as the EA and anticipated construction schedule.

Many open houses have been held as part of the Touquoy Gold Project over the past decade. More recently, in spring 2016, four meetings were held to update the local communities on the construction start of the Touquoy Gold Project and the proposed Beaver Dam Mine Project. In response to concerns on traffic potentially associated with the work at the Touquoy Gold Project, a town hall meeting was held in Mooseland in late 2016.

3.2.3 Presentations and Meetings with Local Community Groups

Atlantic Gold has made presentations to many organizations, community groups and educational institutions on its exploration and mine development activities in Nova Scotia. To date, these organizations include but are not limited to, Sheet Harbour Chamber of Commerce, Council of the Municipality of the District of St. Mary's, and engineering students at Dalhousie University. Depending on interest of community groups, Atlantic Gold will continue to make presentations to share information about its operations in Nova Scotia.

Atlantic Gold has and will continue to meet with local community groups in a smaller venue, including the Eastern Shore Forestry Watch, Moose River Gold Mines Museum Society and Nova Scotia Salmon Association. Depending on interest of community groups as the MRC Project develops, Atlantic Gold will continue to meet with community groups to provide information and respond to any concerns. This may include local ATV clubs, environmental groups, business development organizations and other interested community groups.

3.2.4 Newsletters

Atlantic Gold is developing a quarterly community newsletter. The purpose of the newsletter will be to continue to keep the community informed about the MRC Project. The first edition of this newsletter is planned to be mailed out prior to start of operation of the Touquoy Gold Project to help encourage engagement and increase information dissemination. Afterward the newsletter will be posted online and emailed to those interested in receiving the regular newsletter.

3.2.5 Signage

Atlantic Gold posts signs at MRC Project sites with contact details and other general information. For example, in the instance of the Touquoy Gold Project, the blasting schedule is posted for public information. Working with local groups, such as the Moose River Gold Mine Museum Society, interpretative panels on the MRC Project may be integrated into the Moose River Gold Mine Provincial Park.

3.2.6 Website, Email and other Digital Media

Atlantic Gold is developing a “Community” tab on their organizational website. The purpose of this tab is to:

- Inform and update the public about the Project;
- Address community questions gathered from other communication channels; and
- Provide information for further engagement.

Atlantic Gold has established an email address - communityrelations@atlanticgoldcorporation.com - specifically as a point of contact for the public that will be monitored regularly.

The website will facilitate the development of an email list for interested members of the public. The website also allows interested members of the public to sign up for newsletter.

Atlantic Gold will monitor various social media channels for posts and comments regarding the MRC Project. The purpose of this monitoring will be to check for information being shared regarding the MRC Project, to better understand public questions and concerns, and to identify opportunities to engage. Atlantic Gold will also explore the potential of creating their own social media presence.

3.2.7 Media and Press Releases

Atlantic Gold posts news releases to promote accurate information about the MRC Project. Most news releases to date are associated with Atlantic Gold’s business interests; however, this will be expanded to include Nova Scotia media outlets in order to better communicate the benefits of the mine developments with the broader community, address public questions and concerns, and encourage engagement.

3.2.8 Meetings with Local Residents and Land Owners

Meetings with local residents and land owners have occurred opportunistically where specific interests are expressed. This will continue especially as it relates to land owners associated with the haul road and mine site at Beaver Dam.

3.2.9 Complaints Response Procedure

Associated with the ongoing work for the Touquoy Gold Project, a formal complaints response procedure has been developed and is implemented by Atlantic Gold staff when a complaint is received from the public. This information is shared with the CLC and Nova Scotia Environment on a quarterly basis.

3.3 Regulatory Consultation

Regulatory engagement on the Beaver Dam Mine Project has been ongoing since October 2014 with a Provincial "One Window Process: Mineral Development in Nova Scotia" meeting. This initial meeting was intended to present the planned Project and to receive feedback on the regulatory regime and regional expertise.

Departments from federal and provincial governments have been consulted on Beaver Dam Mine Project, including:

- CEA Agency;
- Fisheries and Oceans;
- Environment and Climate Change Canada;
- Canadian Wildlife Service;
- Health Canada;
- Transport Canada;
- Natural Resources Canada;
- Nova Scotia Environment;
- Nova Scotia Transportation and Infrastructure Renewal;
- Nova Scotia Department of Natural Resources; and
- Nova Scotia Office Aboriginal Affairs.

Consultation includes one-on-one meetings or correspondence, larger meetings or workshops and site visits. A one-day workshop was held on May 13, 2016 for interested provincial and federal regulators. On November 29, 2016 a site visit and tour was held for interested provincial and federal regulators and representatives of the two closest Mi'kmaq communities, Sipekne'katik and Millbrook, and staff of the Kwilmu'kw Maw-klusuaqn Negotiation Office (KMKNO).

3.4 Public Engagement Activities

While broader engagement on the MRC Project has occurred for over a decade and will continue as per the community engagement strategy, specific public engagement activities have occurred to support the EA for the Beaver Dam Mine Project since the federal process was commenced in December 2015. Specifically, this includes community open houses and ongoing two-way information sharing with the CLC. These are detailed below and are included in the summary of engagement activities conducted with stakeholders and the Mi'kmaq of Nova Scotia since EA commencement in December 2015 (**Appendix B).**

3.4.1 Community Open Houses

Four open houses were held in May 2016; two of these were open to the public while the other two were open to First Nations community members as described under Indigenous Peoples engagement.

The two public open houses were advertised in the local papers, including the Eastern Shore Cooperator (monthly print issued on May 5), Guysborough Journal (weekly print issued on May 16) and the Town Cryer (monthly print issued on May 2). The members of the CLC also circulated information. Flyers were also posted in local communities. The dates and locations were as follows:

- May 18, 2016 at Natural Resources Education Centre, 12014 Hwy 224, Middle Musquodoboit
- May 19, 2016 at Sheet Harbour Lions Club, 183 Pool Road, Sheet Harbour

The format and layout were the same for all open houses. Each open house was hosted from 3pm to 8pm with refreshment provided. Upon entry, attendees were asked to sign in and were provided a comment form to complete at end of their stay. Maps were also available for viewing on table and a 3D model of the Beaver Dam mine site was used to demonstrate the existing conditions, proposed full mine development (including pit and waste rock pile) and reclamation of the site.

A total of fifteen panels were placed on easels with Atlantic Gold staff and its consultants hosting the panels. After a welcome and introduction to Atlantic Gold and the MRC Project background (three panels), an overview of open pit mining, process of gold recovery, and economic benefits of the MRC Project was provided (three panels). The next three panels provided an update on the Touquoy Gold Project which was soon to begin construction (June 2016). Before the one closing panel, the five panels focused on the Beaver Dam Mine Project and the engagement opportunities, specifically:

- Presentation of the site location, the gold deposit and the existing site features;
- Map of the proposed site plan at the Beaver Dam Gold Mine;
- Information on the transportation of ore, including both options considered for the route and the trucking rate;
- Overview of the EA process for Beaver Dam Mine Project including the ongoing baseline studies for the VCs and the regulatory process with opportunities for public participation; and

- Opportunities for community and Mi'kmaq engagement, including an overview of the CLC and an invitation for expressions of interest from residents who are interested in joining the CLC.

A total of 94 interested community members attended these two open houses (i.e., Middle Musquodoboit had a total of 61 attendees with 49 providing contact information and/or contact information; Sheet Harbour had a total of 33 attendees with 32 providing name and/or contact information). In total, nine comment forms were completed, two expressed interest in joining the CLC, and many resumes were provided to Atlantic Gold.

3.4.2 Community Liaison Committee

Six CLC meetings were held in 2016. Of these, the last two meetings held on October 29, 2016 and December 3, 2016 included the expanded membership of nine. The CLC membership represents different communities, including: Middle Musquodoboit, Millbrook First Nation, Mooseland, Musquodoboit Harbour, Sheet Harbour, Sipekne'katik First Nation, Pleasant Harbour, and Upper Musquodoboit.

Each community is represented by one member except for Mooseland which has two representatives due to its proximity to the Touquoy Gold Project and the proposed haul route for the Beaver Dam ore.

Due to the ongoing preparation of the EIS for the Beaver Dam Mine Project, a special meeting on December 3, 2016 was held to focus on the Project. As per the Terms of Reference, the CLC may invite guests who may be interested in topics in forthcoming meetings. The CLC invited representatives from the Eastern Shore Forestry Watch (Barbara Markovits and two guests) and the Nova Scotia Salmon Association (Eddie Halfyard and guest).

The meeting was about 2.5 hours in duration. Presentations were made by staff of Atlantic Gold and the EA Study Team, maps were provided and a 3D model of the Beaver Dam mine site was used to demonstrate the existing conditions, proposed full mine development (including pit and waste rock pile), and reclamation of the site. Questions and answers were facilitated. The agenda included:

- Introduction and special purpose of the meeting;
- Overview of the Beaver Dam Mine Project;
- Review of participation opportunities in the federal and provincial EA processes;
- Presentation of summary assessment for each VC; and
- Description of timelines of the Beaver Dam Mine Project.

Offers to meet with specific members of the CLC and/or NGOs present to provide additional information on the Project were made by Atlantic Gold.

3.5 Key Issued Raised and Proponent Responses

The following table provides a summary of key issues raised during public consultation and engagement activities relative to the EA of the Beaver Dam Mine Project. For each key issue identified, a summary of the Proponent's response is provided along with reference(s) to sections in the EIS which more fully addresses the issue.

Table 3.4-1 Summary of Key Issues Raised During Stakeholder Engagement

Key Issue	Summary of Proponent Response	Primary EIS Reference
Concern about metals leaching from waste rock pile, including arsenic, and acid rock drainage	Leaching of metals is not expected, e.g., arsenic is expected to be within baseline conditions. Acidic runoff is not anticipated to be a concern. Surface water management and monitoring will be in place to identify trends.	Section 6.2.3.4 Bedrock Geology; Section; 6.3 Surface Water, including 6.3.7 Mitigation and Monitoring
Concern about effect on water quantity in Cameron Flowage from pit development	Local hydrogeological conditions ensure that groundwater will be maintained to recharge Cameron Flowage. Baseline and ongoing monitoring of surface water and groundwater levels will be in place to identify trends.	Section 6.4.6 Project Activities and Groundwater Quality and Quantity Interactions and Effects
Questions about contingency planning for accidents and malfunctions	Hazards have been identified and assessed based on risk with mitigations and contingency planning in place. Future detailed planning and implementation of the Project will further address potential accidents and malfunctions.	Section 6.15 Accidents and Malfunctions
Concern about wetlands being impacted at mine site and future compensation	Where possible, wetlands have been avoided; otherwise minimization of effects was incorporated into Project planning. Any wetlands altered must have NSE approval and will require compensation.	Section 6.5 Wetlands, including 6.5.7 Mitigation and Monitoring
Questions about addressing species at risk if identified in Project area	Species of conservation interest (SOCI) and species at risk (SAR) have been assessed. Effect is minimal and where a potential Project interaction, mitigation and monitoring plans are identified for priority species, including fish, vascular flora and lichens, terrestrial fauna and birds.	Section 6.10.7 Mitigation and Monitoring for SOCI and SAR.
Concern about effect on habitat from haul road construction	Effects of road construction will be minimized by using existing corridors where possible and improving drainage where damaged culverts exist. Effects and mitigation measures ae specifically identified for ecological VCs, including habitat and flora.	Section 2.2 Haul Roads for Transporting Ore, and key sections for each VC in Section 6 Environmental Effects Assessment.
Concern about volumes of truck traffic in context of safety on public roadways and recreational vehicles	Potential interaction exists with operation of the haul road and the public; the risk of a mobile equipment accident has been assessed as low with mitigations in place including	Section 2.3.2.2 Haul Road; Section 6.13.6 Project Activities and Health and Socio-economic Conditions

Table 3.4-1 Summary of Key Issues Raised During Stakeholder Engagement

Key Issue	Summary of Proponent Response	Primary EIS Reference
	design of Hwy 224 crossing, appropriate signage, and haul truck driver training	Interactions and Effects; and 6.15.3.7 Mobile Equipment Accident
Request to prefer haul route option that does not travel along Hwy 224	Based comments received on two options during the stakeholder and Mi'kmaq engagement, Atlantic Gold completed a feasibility review of the second option which does not pass by any residences. This was selected and is carried forward in the EA.	Section 2.2.2 Haul Roads for Transporting Ore; Section 2.3.4 Summary of Changes to Project Activities; Section 2.6.6 Ore Transportation
Concern on cyanide use at plant for gold processing	The approved Touquoy Gold Project includes a gravity/CIL processing of the ore using a highly efficient cyanide destruction process. This use of this existing plant will be extended for the processing of ore from Beaver Dam. Mitigations for transportation, handling storage and processing will be incorporated into the extended use of the plant.	Section 2.3 Operations and Maintenance associated with the processing plant; Section 2.6.4 Ore Processing Methods;
Concern on effect of tailings disposal in mined-out Touquoy pit	Use of the approved pit as part of the Touquoy Gold Project allows the existing footprint to be used and eliminates the need to process the tailings at the Beaver Dam mine site. Geological conditions predict minimal effect on the receiving environment; conditions will be monitored and compared with the developing baseline data set for the Touquoy Gold Project.	Section 2.3 Operations and Maintenance associated with tailings management, and key sections for surface water and groundwater in Section 6 Environmental Effects Assessment
Request to be informed on the Project activities	Atlantic Gold is committed to maintaining its CLC for the life of the MRC Project, including Beaver Dam Mine Project. Other aspects of community engagement will continue as per the community engagement strategy.	Section 3.6 Ongoing Community Engagement; Section 6.13.7 Mitigation and Monitoring associated with socio-economic considerations

The issues raised during public consultation and engagement activities were incorporated into the design of the Project and the development of the EIS. Improvements to planning and design as a result of feedback from this engagement includes, but is not limited to, minimizing Project footprint, including limiting direct effects to watercourses and wetlands, and changing the haul route to cross Hwy 224 rather than travel along Hwy 224 to avoid passing by residences and to minimize travel on Hwy 224. In terms of the development of the EIS, there were no additional VCs included other than those identified in the CEA Agency Guidelines; however, many specific monitoring commitments have been made by Atlantic Gold to address concerns, including noise and dust associated with the haul route. The Proponent has made strong commitments to ongoing community engagement, including local community organizations. These commitments are summarized in Sections 9 and 10.

The meetings, site visits, telephone calls, emails, and other correspondence that formed the stakeholder and the Mi'kmaq of Nova Scotia engagement activities are included in **Appendix B.**

3.6 Ongoing Community Engagement

As per the engagement strategy, there are many tools to engage stakeholders, including members of the local community, government regulators, NGOs, land owners, and members of the public. As part of submitting the EIS to respective government authorities, the engagement to date associated with the Beaver Dam Mine Project was documented, including a summary of issues raised and Proponent responses. Atlantic Gold has a broad objective to continue to engage the community and will continue to implement its strategy. Relative to the Beaver Dam Mine Project, specific commitments are made by Atlantic Gold in terms of engagement during the next steps in the EA processes, including:

- Sharing key aspects of the EIS with interested NGOs and/or CLC members;
- Holding meetings with interested NGOs, including Eastern Shore Forestry Watch Association and Nova Scotia Salmon Association;
- Aligning in data collection and mitigation measures with local organizations, specifically with the ongoing field work of Nova Scotia Salmon Association; and
- Answering specific questions posed directly to the company by providing additional information where feasible.

As part of the understanding that engagement plans need to be flexible, Atlantic Gold will address and respond to additional stakeholders identified or issues noted as the EA moves forward and into Project development, operation and reclamation.

4. Indigenous Peoples Consultation and Engagement Program

4.1 Objectives

Atlantic Gold is committed to meaningful engagement of the Mi'kmaq of Nova Scotia as part of its MRC Project. Engagement began as part of planning and environmental assessment of the Touquoy Gold Mine over a decade ago. This engagement has focused on the Assembly of Nova Scotia Mi'kmaq Chiefs and staff of the KMKNO, as well as the community members, staff and Chief and Council of each of the nearest two Mi'kmaq communities, Millbrook and Sipekne'katik First Nations.

While the government's duty to consult cannot be delegated to proponents, procedural aspects can be delegated. In addition, both the federal and provincial EA processes include requirements for engagement of Indigenous Peoples. The information gathered by the proponent during its engagement with Indigenous Peoples helps to contribute to the Crown's understanding of any potential adverse impacts of the Project on potential or established Aboriginal or treaty rights, title and related interests, and the effectiveness of measures proposed to avoid or minimize those impacts.

The Made-in-Nova Scotia Process is the forum for the Mi'kmaq, Nova Scotia, and Canada to resolve issues related to Mi'kmaq treaty rights, Aboriginal rights, including Aboriginal title, and Mi'kmaq governance. The process involves the Mi'kmaq of Nova Scotia as represented by the Assembly of Nova Scotia Mi'kmaq Chiefs and the provincial and federal governments. Further, the Nova Scotia *Environmental Assessment Regulations* include a requirement to identify concerns of Indigenous People about potential adverse effects and steps taken, or proposed to be taken, by the proponent to address concerns, as well as the steps taken to identify these concerns.

The EIS Guidelines (CEA Agency 2016) for Beaver Dam Mine Project's federal EA process give guidance to Atlantic Gold to complete specific aspects of Mi'kmaq engagement. For indigenous groups with potential to be most affected by the Project, it was expected that Atlantic Gold would strive toward developing a productive and constructive relationship based on ongoing dialogue with the groups in order to support information gathering and effects assessment. In addition, federal funding was provided under CEAA 2012 to support Indigenous Peoples participation in the EA; this includes funding awarded to the KMKNO and to Millbrook and Sipekne'katik First Nations.

As part of planning the Beaver Dam Mine Project, including preparation of the EIS, engagement has continued with the Mi'kmaq of Nova Scotia. The specific engagement activities related to Project are identified in the EIS. Beyond the regulatory requirements, Atlantic Gold strongly believes that meaningful and long term engagement of the Mi'kmaq of Nova Scotia is crucial to the success of any development. The Proponent is committed to maintaining Mi'kmaq engagement throughout the life of its MRC Project; these activities extend well beyond the EA process of the Beaver Dam Mine Project.

4.2 Indigenous People in Nova Scotia

The Mi'kmaq are the founding people of Nova Scotia and remain the predominant Indigenous Peoples within the Province. The courts have confirmed that the Mi'kmaq of Nova Scotia have rights protected under Section 35 of the *Constitution Act*. The nature and extent of those rights, as well as the responsibilities and authorities of governments with respect to those rights, remain largely undefined and are often before the courts or are under negotiation.

Mi'kmaq Nation of Nova Scotia has a general interest in all lands and resources as the Mi'kmaq Nation maintain that they did not give up their land rights through treaty, voluntary cessation, or otherwise. The Mi'kmaq of Nova Scotia maintains a claim of Aboriginal title to the lands and waters of Nova Scotia and adjacent areas of the offshore. In Canada and Nova Scotia, there have been several legal decisions regarding Aboriginal title; while the Made-in-Nova Scotia Process is informed by the various court decisions, it is understood that court decisions should not restrict the ability under this Process to make broader policy choices and enter into practical arrangements to resolve issues related to Mi'kmaq treaty rights, Aboriginal rights, including Aboriginal title, and Mi'kmaq governance.

The Framework Agreement for the Made-in-Nova Scotia Process was signed in 2007. After a three-year pilot period the thirteen Mi'kmaq communities, through the Assembly of Nova Scotia Mi'kmaq Chiefs, signed an agreement in 2010 with the Governments of Canada and Nova Scotia. The resulting Mi'kmaq-Nova Scotia-Canada Consultation Terms of Reference lays out a process for the parties to follow when governments wish to consult with the Mi'kmaq of Nova Scotia. The Made-in-Nova Scotia Process and the historic development of the Consultation Terms of Reference are based on the principle of the Mi’kmaq of Nova Scotia as one Mi’kmaq Nation.

Nova Scotia has thirteen Mi'kmaq First Nations with a total registered population of 16,760 as of 2017, including both on- and off-reserve populations (AANDC 2017). The Assembly of Nova Scotia Mi’kmaq Chiefs represents eleven of the communities. The Kwilmu’kw Maw-klusuaqn Negotiation Office (KMKNO) is the group that represents the Assembly of Nova Scotia Mi’kmaq Chiefs in the consultation and negotiations with the Province of Nova Scotia and the Government of Canada as part of the Made-in-Nova Scotia Process.

As part of engagement of the Mi’kmaq of Nova Scotia, the following are groups who were listed in the CEAA 2012 Guidelines as being possibly affected by the Project. These include the thirteen Mi'kmaq First Nations in Nova Scotia, the Assembly of Nova Scotia Mi’kmaq Chiefs, and the KMKNO:

- Acadia First Nation;
- Annapolis Valley First Nation;
- Bear River First Nation;
- Chapel Island First Nation;
- Eskasoni First Nation;
- Glooscap First Nation;
- Membertou First Nation;
- Millbrook First Nation;
- Paq’tnkek (Afton) First Nation;
- Pictou Landing First Nation;
- Sipekne’katik First Nation;
- Wagmatcook First Nation;
- We’koqma’q First Nation and
- Assembly of Nova Scotia Mi’kmaq Chiefs and the KMKNO.

In addition, there is a Native Council of Nova Scotia which is a self-governing authority for the large community of Mi'kmaq or other Indigenous Peoples residing off-reserve in Nova Scotia. The Native Council has established thirteen geographic zones encompassing the Province of Nova Scotia and has an elected Office of Chief and President.

The two closest Mi'kmaq communities of Millbrook and Sipekne'katik First Nations have registered total populations of 1,831 and 2,645, respectively (AANDC 2017). Recently each community has chosen to represent themselves directly in the Made-in-Nova Scotia Process in its consultation and negotiation with the Crown rather than remaining as part of the Assembly. As part of Millbrook First Nation, there are two communities near the Beaver Dam Mine Project: Beaver Lake IR I7 with an on-reserve population of about 21 and Sheet Harbour IR 36 with an on-reserve population of about 25 (Statistics Canada 2017).

The approach to Mi'kmaq engagement and development of the EIS has been in keeping with this framework for engaging the Mi'kmaq of Nova Scotia as a Nation via the KMKNO while specific issues relating to the closest communities have been focus of engagement with Millbrook and Sipekne'katik First Nations. This same approach has been used when discussing the sharing of potential Project benefits with the Mi'kmaq of Nova Scotia; that is, Atlantic Gold was directed by KMKNO to discuss directly with Sipekne'katik and Millbrook First Nations, as well as holding discussions with the KMKNO on behalf of the Assembly.

4.3 Engagement Strategy

An engagement strategy for the Mi'kmaq of Nova Scotia has been developed by Atlantic Gold for the development, operation and reclamation of the MRC Project, which includes the permitted and under construction Touquoy Gold Mine and the proposed Beaver Dam Mine Project. Like the strategy for community engagement, it sets out the formal engagement activities with the Mi'kmaq of Nova Scotia that Atlantic Gold will undertake throughout all phases of its exploration activities and mining operations in Nova Scotia. Over time, this also may include additional developments based on results of the ongoing advanced exploration activities at Cochrane Hill and Fifteen Mile Stream.

Engagement planning for Indigenous Peoples is specific and unique to the Mi'kmaq of Nova Scotia; however, it aligns with the broader community engagement activities where appropriate. Like the planning for community engagement, the Mi'kmaq engagement plans allow for flexibility to allow adaptation based on feedback from the Mi'kmaq and ongoing development of Atlantic Gold's MRC Project. The following are general engagement tools that were described in Section 3.2 which will be built upon over time as the MRC Project develops:

- Community Liaison Committee;
- Open houses and town hall meetings;
- Presentations and meetings with local community groups;
- Newsletters;
- Signage;
- Website, email and other digital media;
- Media and press releases;

- Meetings with local residents and land owners; and
- Complaints response procedure.

In 2016, Atlantic Gold developed its strategy for Mi'kmaq engagement to coincide with the start of construction of the permitted Touquoy Gold Mine and the development of the EA for the Beaver Dam Mine Project. These elements listed below are specific to Mi'kmaq engagement and are often supported by community engagement activities listed above. These elements of the Mi'kmaq engagement strategy will be built upon over time as the MRC Project develops.

As part of Atlantic Gold's Mi'kmaq engagement strategy, the following elements will be further developed to build on the decade-long relationship that has been built on mutual understanding and transparency:

- Two-way sharing of meaningful information via face-to-face meetings, development of plain language materials, and site visits;
- Developing benefit agreements with the Assembly and the two closest communities to share Project benefits in terms of economic development, support for training and education and building capacity for future opportunities;
- Supporting cultural and traditional activities of the Mi'kmaq of Nova Scotia;
- Involving the Mi'kmaq of Nova Scotia in ongoing initiatives, such as wetland compensation planning and the CLC; and
- Maintaining flexibility and open lines of communication to adjust the implementation as the relationship and MRC Project develops.

The focus of engagement will be with the Assembly and the KMKNO, the communities of Millbrook and Sipekne'katik, and the Native Council of Nova Scotia. Other interested communities represented by the Assembly will be offered information and opportunity to meet. In addition, Mi'kmaq organizations in Nova Scotia who deliver services to their members will be engaged; for example, the Mi'kmaw Conservation Group has and is developing additional capacity in environmental monitoring, environmental education and habitat restoration. Aligning mutual interests, such as environmental protection specifically related to current use of land and resources for traditional purposes, is a core part of Atlantic Gold's Mi'kmaq engagement strategy. Engagement to date has been positive and productive; this relationship as defined under the 2014 Memorandum of Understanding with the Assembly will continue for the life of all of Atlantic Gold's development in Nova Scotia.

4.4 Indigenous Peoples Engagement Activities

The objective of Mi'kmaq engagement relative to the development of the EIS for the Beaver Dam Mine Project is to gather views from Mi'kmaq groups with respect to both potential environmental effects of the Project and the potential adverse impacts of the Project on potential or established Aboriginal or treaty rights, title and related interests.

While broader engagement on the MRC Project has occurred for over a decade and will continue as per the Mi'kmaq engagement strategy, specific public engagement activities have occurred to support the EA for the Beaver Dam Mine Project since the federal process was commenced in December 2015.

These include aspects specific to the Project including:

- CLC, where two members were appointed by their Chief and Council as representatives of Millbrook First Nation and Sipekne'katik First Nation;
- Open houses, specifically two community open houses occurred in May on lands of Millbrook and Sipekne'katik First Nations prior to the two public open houses;
- Presentations to Chief and Council of Millbrook First Nation and of Sipekne'katik First Nation, as well as the Benefits Committee Chiefs of the Assembly;
- Meetings, information sharing and correspondence with the KMKNO and thirteen Millbrook First Nations of Nova Scotia, as well as the Nova Scotia Native Council for the purpose of good governance;
- Mini employment fairs set up in collaboration with staff of Millbrook and Sipekne'katik First Nations, as well as sharing of employment opportunities with Millbrook and Sipekne'katik First Nations and the KMKNO, with current employment at the under construction Touquoy Gold Project exceeding ten percent;
- Ongoing dialogue on formal agreements in terms of participation and benefits sharing with Millbrook First Nation, Sipekne'katik First Nation and the Assembly;
- Participation of staff of KMKNO and Millbrook and Sipekne'katik First Nations in a site visit and tour of the proposed Beaver Dam Mine Project with provincial and federal regulators on November 29, 2016; and
- Use of many tools for Mi'kmaq engagement that are used for the general community engagement, such as newsletters, signage, website, email and other digital media, media and press releases, meetings with local residents, and a complaints response procedure.

These meetings, calls, site visits and correspondence are included in the summary of engagement activities conducted with the Mi'kmaq of Nova Scotia since EA commencement in December 2015 and are provided in **Appendix** B along with engagement of stakeholders**.**

More detail is provided below on engagement of the two nearest Mi'kmaq communities specific to the Beaver Dam Mine Project.

4.4.1 Community Open Houses

As discussed in Section 3.4.1 of this EIS, four open houses were held in May 2016; two of these were open to the public while the other two were specific to community members of Millbrook First Nation and Sipekne'katik First Nation.

The two Mi'kmaq community open houses were advertised by staff of each community. In addition, community members were invited to attend the two public open houses if convenient (held on May 18, 2016 in Middle Musquodoboit and on May 19, 2016 in Sheet Harbour). The dates and locations for the two Mi'kmaq community open houses were:

- May 16, 2016 at Millbrook Community Hall, 72 Church Rd, Truro
- May 17, 2016 at Saint Kateri Tekakwitha (Church Basement), Indian Brook

The format and layout were the same for all community open houses. Each open house was hosted from 3pm to 8pm with refreshment provided. Upon entry, attendees were asked to sign in and were provided a comment form to complete at end of their visit. Maps were also available for viewing on table and a 3D model of the Beaver Dam mine site was used to demonstrate the existing conditions, proposed full mine development (including pit and waste rock pile) and reclamation of the site.

A total of fifteen panels were placed on easels with Atlantic Gold staff and its consultants hosting the panels. After a welcome and introduction to Atlantic Gold and the MRC Project background (three panels), an overview of open pit mining, process of gold recovery, and economic benefits of the MRC Project was provided (three panels). The next three panels provided an update on the Touquoy Gold Project which was soon to begin construction (June 2016). Before the one closing panel, the five panels focused on the Beaver Dam Mine Project and the engagement opportunities, specifically:

- Presentation of the site location, the gold deposit and the existing site features;
- Map of the proposed site plan at the Beaver Dam Gold Mine;
- Information on the transportation of ore, including both options considered for the route and the trucking rate;
- Overview of the EA process for Beaver Dam Mine Project including the ongoing baseline studies for the VCs and the regulatory process with opportunities for public participation; and
- Opportunities for community and Mi'kmaq engagement, including an overview of the CLC and an invitation for expressions of interest from residents who are interested in joining the CLC.

A total of 32 interested community members attended these two open houses. Millbrook First Nation had a total of 16 attendees with 9 providing name and/or contact information. Sipekne'katik First Nation had a total of 16 attendees with 14 providing name and/or contact information. In total, four comment forms were completed; many attendees expressed an interest in employment and some provided resumes to Atlantic Gold.

4.4.2 Community Liaison Committee

As discussed in Section 3.4.2 of this EIS, the CLC was recently expanded to a nine-member committee including representation of the two closest Mi'kmaq communities, Millbrook First Nation and Sipekne'katik First Nation. The volunteer CLC membership acts as an advisory board to Atlantic Gold and provides a mechanism for two-way information exchange between communities and the company.

A draft Terms of Reference for the CLC was developed and will be finalized by the CLC early in 2017 (refer to **Appendix A**). The Terms of Reference sets out the governance for the CLC and defines its objective as an advisory body the Atlantic Gold with volunteer members representing local communities.

Specific to the Beaver Dam Mine Project, a special meeting was held on December 3, 2016 to focus on the Project. Presentations were made by staff of Atlantic Gold and the EA Study Team, maps were provided and a 3D model of the Beaver Dam mine site was used to demonstrate the existing conditions, proposed full mine development (including pit and waste rock pile) and reclamation of the site. Questions and answers were facilitated.

The agenda included:

- Introduction and special purpose of the meeting;
- Overview of the Beaver Dam Mine Project;
- Review of participation opportunities in the federal and provincial EA processes;
- Presentation of summary assessment for each VC; and
- Description of timelines of the Beaver Dam Mine Project.

Offers to meet specifically with Mi'kmaq representatives on the CLC to provide additional information on the Project were made by Atlantic Gold. Discussions are ongoing to coordinate future engagement as per Section 4.6 of this EIS.

4.5 Key Issues Raised and Proponent Responses

As part of submitting the EIS and EARD to respective government authorities, the Mi'kmaq engagement to date associated with the Beaver Dam Mine Project was documented, including a summary of key issues raised and proponent responses at the time of EIS submission. For each key issue identified in the following table, a summary of proponent response is provided along with reference(s) to sections in this EIS which address the issue.

Table 4.5-1 Summary of Key Issues Raised During Mi'kmaq Engagement

Key Issue	Summary of Proponent Response	Primary EIS Reference
Concern about air emissions and noise associated with mining operations and trucking	Air emissions and noise will be minimized with mitigation measures. Monitoring for air quality, including total suspended particulates, will be completed.	Section 6.1.7 Mitigation and Monitoring for Atmospheric Environment
Concern about water quality and quantity and potential effect on fish habitat	Surface water management associated with mining and processing is necessary to minimize effect on receiving water. Monitoring of surface water will be completed to identify any trends to ensure no residual effect on fish habitat.	Section 6.3 Surface Water; Section 6.6.6 Project Activities and Fish and Fish Habitat Interactions and Effects
Concern about effect on groundwater, specifically related to domestic wells at Beaver Lake, from development of pit at Beaver Dam	As the nearest domestic well is over 5km from the mine site, no effect is expected on groundwater quality or quantity at Beaver Lake. A network of monitoring wells will be used to monitor groundwater quality and quantity at the Beaver Dam mine site.	Section 6.4.6 Project Activities and Groundwater Quality and Quantity Interactions and Effects
Questions about plans for reclamation at the Beaver Dam mine site	The mine site facilities will be removed, the pit will naturally fill with water and disturbed surfaces covered with stockpiled topsoil and re-vegetated. The site will be returned to land owner for forestry and recreational use.	Section 2.3.3 Decommissioning and Reclamation
Questions about contingency planning for accidents and malfunctions	Hazards have been identified and assessed based on risk. Mitigation measures and contingency planning will be in place to address potential accidents and malfunctions.	Section 6.15 Accidents and Malfunctions
Concern on habitat loss from Project development, including forest, wetlands, flora and fauna	Disturbance exists on the mine site which will be reclaimed at end of operation. The existing alignment of haul road was used where feasible and practical to minimize footprint. Existing facilities will be used for processing and tailings management. Effect on habitat is minimal.	Section 2.2 Project Location and History, as well as effects assessments in Section 6
Concern about effect of haul truck traffic on birds	There is potential effect on birds due to noise and dust from haul truck traffic as well as potential bird strikes. This effect is limited to operational phase and was assessed to not be significant.	Section 6.9.6 Project Activities and Birds Interactions and Effects
Concern about effect on traditional uses of the Mi'kmaq of Nova Scotia	Traditional uses include hunting, fishing, trapping and gathering medicinal food and plants as per the MEKS completed. Mitigation measures to protect the	Section 6.11.6 Project Activities and Indigenous Peoples Interactions and Effects; Appendix N

Table 4.5-1 Summary of Key Issues Raised During Mi'kmaq Engagement

Key Issue	Summary of Proponent Response	Primary EIS Reference
	environment and ongoing engagement will minimize any effect to traditional use and access to resources.	Mi'kmaq Ecological Knowledge Study
Request to prefer haul route option that does not travel along Hwy 224	Based comments received on two options during the stakeholder and Mi'kmaq engagement, Atlantic Gold completed a feasibility review of the second option which does not pass by residences, including Beaver Lake IR17. This was selected and is carried forward in the EA.	Section 2.2.2 Haul Roads for Transporting Ore; Section 2.3.4 Summary of Changes to Project Activities; Section 2.6.6 Ore Transportation
Questions about cumulative effects of multiple projects in the region	A cumulative effects assessment was completed for each VC including current use of lands and resources for traditional purposes. Ongoing engagement specific to Atlantic Gold's existing and any future projects will also occur with the Mi'kmaq of Nova Scotia.	Section 8.6 Cumulative Effects Summary; Section 4.7 Ongoing Indigenous Peoples Engagement
Request ongoing engagement of the Mi'kmaq of Nova Scotia	Atlantic Gold is committed to ongoing Mi'kmaq engagement for the life of the MRC Project, including Beaver Dam Mine Project. Other aspects of Mi'kmaq engagement will continue as per the Mi'kmaq engagement strategy with focus on issues identified as part of the EA and additional issues that may arise as the Project develops.	Section 4.7 Ongoing Indigenous Peoples Engagement; Section 6.11.7 Mitigation and Monitoring associated with Indigenous Peoples

The issues raised during Mi'kmaq engagement activities were incorporated into the design of the Project and the development of the EIS. The fundamental change to the Project as a result of Mi'kmaq engagement was the change to the haul route to cross Hwy 224 which eliminated the haul trucks passing by the Mi'kmaq community of Beaver Lake. This addressed many concerns with safety, noise, air, and light emissions and other issues related to health and socio-economic aspects. It is the understanding of the Proponent based on engagement with the Mi'kmaq that the changed haul route was seen as a positive change as effects on the community of Beaver Lake were minimized.

In terms of the development of the EIS, there were no additional VCs included in addition to those identified in the CEA Agency Guidelines associated with the input from the Mi'kmaq of Nova Scotia. The VCs listed in the Guidelines addressed the issues brought forward during engagement. However, specific attention was paid to effects assessment of specific VCs, in particular groundwater and its potential effect on the potable water supply of Beaver Lake and the effect on local surface and groundwater quantity from pit development. In addition, focused questions from the Mi'kmaq of Nova Scotia on potential effects of accidents and malfunctions enhanced the development of this portion of the EIS, including the commitments to contingency planning.

As part of the Proponent's engagement of the Mi'kmaq completed to date on the Beaver Dam Mine Project, the potential effects and the proposed mitigation measures and monitoring programs were generally presented and discussed. The objective was to provide information on the Project to the Mi'kmaq and for the Proponent to better understand the views of the Mi'kmaq on the potential effects and proposed mitigation measures and monitoring programs; this supported the development of the EIS. It is the opinion of the Proponent that Mi'kmaq groups engaged were open to the Project as presented with its mitigation measures and monitoring programs; however, the views of the Mi'kmaq will be further developed as part of the detailed review of this EIS once released as part of their participation in the federal and provincial EA processes, including the federal funding allocated to the Mi'kmaq of Nova Scotia represented by the KMKNO and Sipekne'katik and Millbrook First Nations.

In response to the interest of the Mi'kmaq, the Proponent has made strong commitments to ongoing Mi'kmaq engagement, including specific activities to further support the participation of the Mi'kmaq in this EA process for the Beaver Dam Mine Project. The ongoing engagement ensures that the potential effects of the Project and the proposed mitigation measures and monitoring programs are understood by the Mi'kmaq of Nova Scotia in order to evaluate the effects on their communities and potential or established Aboriginal or treaty rights, title and related interests. It is anticipated the outcomes of ongoing engagement throughout the EA process and beyond will support the Project detailed design in all phases from pre-construction data collection to final reclamation.

The key meetings, site visits, telephone calls, emails, and other correspondence with Mi'kmaq groups engaged are tabulated in **Appendix B** along with engagement of stakeholders**.**

4.6 Ongoing Indigenous Peoples Engagement

As part of submitting the EIS and EARD to respective government authorities, the engagement to date associated with the Beaver Dam Mine Project was documented, including a summary of issues raised and proponent responses. Atlantic Gold has a broad objective to continue to engage the community and will continue to implement its strategy.

Relative to the Beaver Dam Mine Project, specific commitments are made by Atlantic Gold in terms of Mi'kmaq engagement during the next steps in the EA processes, including:

- Offering to share key aspects of the EIS with staff of Millbrook and Sipekne'katik First Nations and the Assembly, including the MEKS;
- Holding meetings with key staff of KMKNO and Millbrook and Sipekne'katik First Nations;
- Offering opportunities for presentations and site visits to Chief and Councils, specifically Millbrook and Sipekne'katik First Nations,
- Having additional community open houses or site visits as deemed appropriate in consultation with staff and/or leadership of Mi'kmaq communities; and
- Answering specific questions posed directly by the Mi'kmaq to the Proponent by providing additional information and/or holding meetings where feasible.

As part of understanding that engagement planning need to be flexible, Atlantic Gold will address and respond to additional questions or concerns identified or issues noted as the EA moves forward into Project development, operation and reclamation.

Atlantic Gold has a broad objective to continue to engage the Mi'kmaq of Nova Scotia and will continue to implement its strategy. Atlantic Gold is strongly committed to continue its engagement with the Mi'kmaq of Nova Scotia in the ongoing spirit of cooperation and with mutual benefit and respect.

5. Environmental Effects Assessment Methodology

5.1 Scope of the Environmental Assessment

5.1.1 Designated Project

The Project being assessed through this EIS is a proposed surface gold mine consisting of the construction, operation, and decommissioning of a surface mine, haul road, and processing facility, known as the Beaver Dam Mine Project. The project will encompass three primary locations spanning from Marinette to Moose River Gold Mines, Halifax County, Nova Scotia.

The scope of the Project to be assessed in accordance with *CEAA 2012* and the *Environmental Assessment Regulations* made under the *Nova Scotia Environment Act* include the following components and activities:

Physical Components

- surface mine for extracting ore and waste rock,
- mine site roads,

- waste material storage piles for waste rock, till, and topsoil,
- Run-of-mine (ROM), high grade, and low grade ore stockpiles,
- crusher and operational facilities, and
- water management;
- haul roads for transporting ore; and
- Touquoy processing and tailings management facility.

Physical Activities

- clearing, grubbing, and grading;
- drilling and rock blasting;
- topsoil, till, and waste rock management;
- existing settling pond dewatering;
- watercourse and wetland alteration;
- mine site road construction;
- surface infrastructure installation and construction;
- collection and settling pond construction;
- culvert and bridge upgrades and construction;
- haul road construction and upgrades;
- ore processing equipment upgrades;
- tailings line alteration;
- surface mine dewatering;
- ore management;
- waste rock management;
- surface water management;
- petroleum products management;
- site maintenance and repairs;
- ore transport;
- haul road maintenance and repairs;
- tailings management;
- infrastructure demolition;

- site reclamation;
- environmental monitoring; and
- general waste management.

These components and activities reflect the scope of the Project outlined in Section 3.1 of the EIS Guidelines and reflect the components and activities that would occur throughout the duration of the Project. The effects assessment outlined in Section 6 of this EIS is formed based on these components and activities. No facilities for the manufacture and storage of explosives will be present on site; therefore these items are excluded from the Project scope.

Refer to Section 2.4 and Section 2.5 of this EIS for additional details regarding Project components and activities. Refer to Tables 5.7-1, 5.7-2, and 5.7-3 for a review of the potential interactions between VCs and the Project components/activities outlined above.

5.1.2 Factors to be Considered

This EIS considers all factors outlined in Section 19(1) of *CEAA 2012* and Section 3.2 of the EIS Guidelines. Specifically, this includes the following:

- environmental effects of the Project, including the environmental effects of malfunctions or accidents that may occur in connection with the Project and any cumulative environmental effects that are likely to result from the Project in combination with other physical activities that have been or will be carried out;
- the significance of effects;
- comments from the public ;
- mitigation measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the Project;
- the requirements of the follow-up program in respect of the Project;
- the purpose of the Project;
- alternative means of carrying out the Project that are technically and economically feasible and the environmental effects of any such alternatives;
- any change to the Project that may be caused by the environment; and
- the results of any relevant regional study pursuant to CEAA 2012.

5.1.3 Scope of Factors to be Considered

The scope of the factors to be considered focuses this EIS on relevant issues and concerns. As indicated in Section 5(1) of *CEAA 2012*, the environmental effects that are to be considered regarding an act or thing, a physical activity, a designated project, or a project are:

(a) a change that may be caused to the following components of the environment that are within the legislative authority of Parliament:

  o *(i) fish and fish habitat as defined in subsection 2(1) of the* Fisheries Act*,*

- *(ii) aquatic species as defined in subsection 2(1) of the* Species at Risk Act*,*
- *(iii) migratory birds as defined in subsection 2(1) of the* Migratory Birds Convection Act, 1994*, and*
- *(iv) any other component of the environment that is set out in Schedule 2;*

(b) a change that may be caused to the environment that would occur

- *(i) on federal lands,*
- *(ii) in a province other than the one in which the act or thing is done or where the physical activity, the designated project or the project is being carried out, or*
- *(iii) outside Canada; and*

(c) with respect to aboriginal peoples, an effect occurring in Canada of any change that may be caused to the environment on

- *(i) health and socio-economic conditions,*
- *(ii) physical and cultural heritage,*
- *(iii) the current use of lands and resources for traditional purposes, or*
- *(iv) any structure, site, or thing that is of historical, archaeological, paleontological, or architectural significance.*

Certain additional environmental effects must be considered under Section 5(2) of CEAA 2012 where the carrying out of the physical activity, the designated project, or the Project requires a federal authority to exercise a power or perform a duty or function conferred on it under any Act of Parliament other than *CEAA 2012*. As the Project may require an authorization from DFO, the following environmental effects have also been considered:

(a) a change, other than those referred to in paragraphs (1)(a) and (b), that may be caused to the environment and that is directly linked or necessarily incidental to a federal authority's exercise of a power or performance of a duty or function that would permit the carrying out, in whole or in part, of the physical activity, the designated project or the Project; and

(b) an effect, other than those referred to in paragraph 1(c), of any change referred to in paragraph (a) on

- *(i) health and socio-economic conditions,*
- *(ii) physical and cultural heritage, or*
- *Any structure, site or thing that is of historical, archaeological, paleontological, or architectural significance.*

These categories of direct and indirect environmental effects have been considered in defining the scope of the assessment, including the selection of VCs and identification of spatial and temporal boundaries.

5.2 Overview of Approach

The methodology used to conduct the EA and predict the effects of the Beaver Dam Mine Project was developed to meet the requirements of the EIS Guidelines issued by CEAA on January 19, 2016. The EIS Guidelines include requirements for EA's under CEAA 2012 and the *Nova Scotia*

Environmental Assessment Regulations made under the *Nova Scotia Environment Act*. In addition to these requirements, the EA methodology was developed to incorporate:

- input from Indigenous Peoples and the public throughout the duration of the Project;
- environmental and social points of interest to the scientific and regulatory communities; and
- other federal, provincial, and municipal legislative and regulatory requirements that may apply to the Project.

The following sections will describe the methodology used to derive:

- the general rationale in valued component selection;
- the spatial, temporal, administrative, and technical boundaries for assessing effects on VCs;
- the standard and/or threshold for characterizing and determining significance of residual effects;
- the programs developed to assess the baseline condition of those VCs;
- the anticipated Project and environment interactions for the duration of the Project;
- the prediction of effects Project activities may have on VCs;
- the mitigation measures that will be used to eliminate, reduce, or control the potential effects of Project activities;
- the residual effects that may remain after mitigation measures are applied and the significance of those residual effects;
- the cumulative effects residual effects of the Project may have in combination with the residual effects of other projects within temporal and spatial confines of the Project;
- the follow-up and monitoring programs proposed to verify the accuracy of predicted impacts; and
- the effects of the environment on the Project.

The defined methodology described herein has allowed the EA Study Team to carefully examine Project activities to ensure they will not cause serious or irreversible harm to the environment.

5.3 Valued Components Selection

The methodology used to conduct this EA is based on the identification and assessment of potential environmental effects of the Project on VCs. VCs refer to environmental, biophysical, or human features that may be affected by the Project that are of value or interest because they have been identified to be of concern to Indigenous Peoples, regulators, the EA Study Team, and/or the general public. Their value not only relates to its role in the ecosystem, but also the value humans place on it.

The selection of VCs was based on consideration of the following:

- regulatory guidance and requirements, specifically those outlined in Section 6.2 of the EIS Guidelines provided by CEAA on January 19, 2016 and Section 5 of CEAA 2012. Refer to Section 5.1.3 of this EIS for a discussion of CEAA 2012 Section 5 requirements;

- a review of federal, provincial, and municipal legislation, including an appraisal of species of conservation interest (SOCI) and SAR. Section 3.3.2 of the EIS Guidelines specifically requires consideration of the factors listed in Section 79 of SARA;
- workshops and discussions with representatives of CEAA, DFO, Environment and Climate Change Canada (ECCC), TC, NSE, and NSDNR;
- concerns raised by the public through open house meetings hosted by Atlantic Gold;
- concerns raised by Indigenous Peoples, including traditional ecological knowledge obtained through completion of a Mi'kmaq Ecological Knowledge Study (MEKS);
- technical aspects of the Project, including the nature and extent of Project activities;
- the existing physical, biophysical, and socio-economic conditions and characteristics of the Project area;
- a review of publically available information and reports submitted in support to nearby and similar environmental assessments; and
- the professional experience of the EA Study Team.

Based on these considerations, the following VCs were selected to facilitate a focused and effective EA:

Physical VCs

- atmospheric environment;
- geology, soil, and sediment quality;
- surface water quality and quantity; and
- groundwater quality and quantity.

Biophysical VCs

- wetlands;
- fish and fish habitat;
- habitat and flora;
- terrestrial fauna;
- birds; and
- Species of Conservation Risk and Species at Risk.

Socio-economic VCs

- Indigenous Peoples;
- physical and cultural heritage; and
- human health and socio-economic conditions.

Table 5.3-1 summarizes the rationale for the selection of each VC; however, the rationale is expanded upon in their corresponding subsection within Section 6 of this EIS.

Table 5.3-1 Rationale for Selection of Valued Components

Environment	Valued Component	Relevance to Environmental Impact Statement: Project – Environment Interaction	Legal Requirement	Scientific Interest	Biophysical Context	Socio-economic Context	Human Health	Human Quality of Life	Cultural	CEAA or Public Concern	Requirement of EIS Guidelines	VC Selection Rationale
Physical Environment	Atmospheric Environment	D I	☑		☑		☑	☑		☑		• Potential for direct adverse effects to air quality • Potential for increases in noise and ambient light levels • Potential for direct contributions to climate change • Pathway for potential adverse effects to surface water quality, wetlands, fish and fish habitat, habitat and flora, birds, fauna, SOCI/SAR, and human health
	Geology, Soil, and Sediment	D I			☑					☑		• Potential for direct adverse effects to soil and sediment • Potential for ARD from Halifax Formation bedrock • Pathway for potential adverse effects to surface water quality, wetlands, fish and fish habitat, habitat and flora, birds, fauna, SOCI/SAR, and human health

Table 5.3-1 Rationale for Selection of Valued Components

Environment	Valued Component	Relevance to Environmental Impact Statement										VC Selection Rationale
		Project – Environment Interaction	Legal Requirement	Scientific Interest	Biophysical Context	Socio-economic Context	Human Health	Human Quality of Life	Cultural	CEAA or Public Concern	Requirement of EIS Guidelines	
	Surface Water Quality and Quantity	D I	☑	☑	☑		☑	☑		☑		• Potential for direct adverse effects to surface water quality • Potential for direct adverse effects to surface water quantity • Pathway for potential adverse effects to wetlands, fish and fish habitat, birds, fauna, SOCI/SAR, and human health
	Groundwater Quality and Quantity	D	☑	☑						☑		• Potential for direct adverse effects to groundwater quality • Potential for direct adverse effects to ground water quantity
Biophysical Environment	Wetlands	D I	☑	☑	☑					☑		• Potential for direct loss and/or adverse effects to wetlands and their function • Pathway for potential adverse effects to surface water quality and quantity, fish and fish habitat, habitat and flora, birds, fauna, and SOCI/SAR
	Fish and Fish Habitat	D I	☑	☑	☑	☑	☑	☑		☑	☑	• Potential for direct adverse effects to fish and fish habitat • Pathway for potential adverse effects to birds, fauna, SOCI/SAR and human health

Table 5.3-1 Rationale for Selection of Valued Components

Environment	Valued Component	Relevance to Environmental Impact Statement										VC Selection Rationale
		Project – Environment Interaction	Legal Requirement	Scientific Interest	Biophysical Context	Socio-economic Context	Human Health	Human Quality of Life	Cultural	CEAA or Public Concern	Requirement of EIS Guidelines	
	Habitat and Flora	D I	☑	☑	☑	☑	☑	☑		☑		• Potential for direct loss of habitat • Potential for direct adverse effects to flora • Pathway for potential adverse effects to the atmospheric environment, surface water quality and quantity, wetlands, fish and fish habitat, birds, fauna, SOCI/SAR, Indigenous Peoples, and human health
	Birds	D I	☑	☑	☑	☑	☑	☑		☑	☑	• Potential for direct adverse effects to birds • Pathway for potential adverse effects to fauna, Indigenous Peoples, and human health
	Fauna	D I	☑	☑	☑	☑	☑	☑		☑		• Potential for direct adverse effects to fauna • Pathway for potential adverse effects to birds, Indigenous Peoples, and human health
	Species of Conservation Interest / Species At Risk	D I	☑	☑	☑					☑	☑	• Potential for direct adverse effects to SOCI/SAR • Pathway for potential adverse effects to birds and fauna

Table 5.3-1 Rationale for Selection of Valued Components

Environment	Valued Component	Relevance to Environmental Impact Statement										VC Selection Rationale
		Project – Environment Interaction	Legal Requirement	Scientific Interest	Biophysical Context	Socio-economic Context	Human Health	Human Quality of Life	Cultural	CEAA or Public Concern	Requirement of EIS Guidelines	
Socio-Economic Environment	Indigenous Peoples	D	☑			☑	☑	☑	☑	☑	☑	• Potential for direct adverse effects to the current use of land and resources for traditional purposes
	Physical and Cultural Heritage	D	☑			☑			☑			• Potential for direct adverse effects to archaeological sites
	Human Health and Socio-economic Considerations	D				☑	☑	☑				• Employment opportunities • Economic spin-off • Contribution to government revenue through taxation

Legend (refer to Section 5.7 for examples)

Type of Interaction

D Direct Interaction

I Indirect Interaction

5.4 Project Boundaries

5.4.1 Temporal Boundaries

The temporal boundaries represent the duration over which Project activities interact with each valued component. Generally, the temporal boundary encompasses all Project phases (construction, operation, and decommissioning and reclamation); however, the temporal boundary can vary depending on the valued component being considered.

The construction phase will be completed in one year, while the operation phase will last four years. Decommissioning and reclamation activities will commence after operation has ceased and likely occur over a three to five year period. Temporal boundaries for each VC are described in their corresponding subsection within Section 6 of this EIS.

5.4.2 Spatial Boundaries

The spatial boundaries represent anticipated geographic limits that will aid in defining the scale and range of interactions between Project activities and VCs. The following spatial boundaries will be used for this EIS.

Project Area (PA)

The PA encompasses the immediate area in which Project activities may occur and are likely to cause direct and indirect effects to VCs. This area has also been identified as the study area for the purposes of baseline investigations. Based on Project activities and components, the three distinct PA's are the Beaver Dam mine site, the haul road corridor, and the Touquoy processing and tailings management facility. Figure 5.4-1 outlines the three PA's (i.e. study areas).

Local Assessment Area (LAA)

The LAA encompasses adjacent areas outside of the PA where Project related effects to VCs are reasonably expected to occur. Generally, the LAA is limited to the area in which Project activities are likely to have indirect effects on VCs; however, the size of the LAA can vary depending on the VC being considered, and the biological and physical variables present.

Regional Assessment Area (RAA)

The RAA encompasses all Project and VC interactions including diffuse or longer range effects such as those from Project activities on the atmospheric environment, Indigenous Peoples, and the health and socio-economic environments. The RAA may vary in size depending on the VC being considered, and the biological and physical variables present.

Spatial boundaries will vary for each VC and are described in Table 5.4-1, as well as their corresponding subsection within Section 6 of this EIS.

Table 5.4-1 Spatial Boundary Assessment by Valued Component

Environment	Valued Component	Project Area	Local	Regional	Spatial Boundary Selection Rationale
Physical Environment	Atmospheric Environment	☑	☑	☑	• Effects from the Project on climate change and greenhouses gasses may potentially occur over a diffuse area and are related to provincial initiatives; therefore the Project area, local assessment area, and regional assessment area are considered. • Effects from the Project on air quality, noise, and ambient light may potentially occur within and immediately adjacent to the Project area; therefore the Project area and local assessment area are considered.
	Geology, Soil, and Sediment	☑	☑		• Effects from the Project on geology, soil, and sediment may potentially occur within and immediately adjacent to the Project area; therefore the Project area and local assessment area are considered.
	Surface Water Quality and Quantity	☑	☑		• Effects from the Project on surface water quality and quantity may potentially occur within and immediately adjacent to the Project area; therefore the Project area and local assessment area are considered.
	Groundwater Quality and Quantity	☑	☑		• Effects from the Project on groundwater quality and quantity may potentially occur within and immediately adjacent to the Project area; therefore the Project area and local assessment area are considered.
Biophysical Environment	Wetlands	☑	☑		• Effects from the Project on wetlands may potentially occur within and immediately adjacent to the Project area; therefore the Project area and local assessment area are considered.
	Fish and Fish Habitat	☑	☑		• Effects from the Project on fish and fish habitat may potentially occur within and immediately adjacent to the Project area; therefore the Project area and local assessment area are considered.
	Habitat and Flora	☑	☑		• Effects from the Project on habitat and flora may potentially occur within and immediately adjacent to the Project area; therefore the Project area and local assessment area are considered.
	Birds	☑	☑		• Effects from the Project on birds may potentially occur within and immediately adjacent to the

Table 5.4-1 Spatial Boundary Assessment by Valued Component

Environment	Valued Component	Project Area	Local	Regional	Spatial Boundary Selection Rationale
					Project area; therefore the Project area and local assessment area are considered.
	Fauna	☑	☑		• Effects from the Project on fauna may potentially occur within and immediately adjacent to the Project area; therefore the Project area and local assessment area are considered.
	Species of Conservation Interest / Species At Risk	☑	☑		• Effects from the Project on species of conservation interest and species at risk may potentially occur within and immediately adjacent to the Project area; therefore the Project area and local assessment area are considered.
Socio-Economic Environment	Indigenous Peoples	☑	☑	☑	• Effects from the Project on Indigenous Peoples may potentially occur over a diffuse area and are provincial and federal initiatives; therefore the Project area, local assessment area, and regional assessment area are considered.
	Physical and Cultural Heritage	☑			• Effects from the Project on physical and cultural heritage are likely limited to the Project area; therefore only the Project area is considered.
	Human Health and Socio-economic Consideration s	☑	☑	☑	• Effects from the Project on human health and socio-economic considerations of the area may potentially occur over a diffuse area; therefore the Project area, local assessment area, and regional assessment area are considered.

5.4.3 Administrative Boundaries

The administrative boundaries represent the regulatory, public policy, and/or economic limitations placed on the execution of the Project. The majority of administrative boundaries for the Project are outlined in Section 1.3 of this EIS. Administrative boundaries for each VC are described in their corresponding subsection within Section 6 of this EIS.

5.4.4 Technical Boundaries

The technical boundaries represent the limits of the EA Study Team's ability to assess a VC. The limitations to measure, assess, and/or monitor the effects of the Project on VCs may be theoretical or physical. These technical boundaries may create gaps in knowledge and understanding related to key conclusions; therefore limiting the EA Study Team's ability to predict potential effects of the Project on a VC. Technical boundaries for each VC are described their corresponding subsection within Section 6 of this EIS.

5.5 Standards or Thresholds for Characterizing and Determining Significance of Effects

Criteria or established thresholds for determining the significance of residual effects from Project activities are described for each VC in their corresponding subsection within Section 6 of this EIS. These criteria or threshold were developed through the following avenues:

- consultation with appropriate regulatory agency responsible for each VC;
- using information obtained in stakeholder and right holder consultation;
- using available information on the status and characteristic of each VC;
- using applicable regulatory documents, environmental standards, guidelines, and/or objectives; and
- using professional judgement of the EA Study Team.

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

Additional analysis as defined in Table 5.10-1 is also identified and supports the characterization and significance determination for residual effects.

5.6 Baseline Conditions

Baseline conditions for each physical, biophysical, and socio-economic VC are described in their corresponding subsection within Section 6 of this EIS in order to characterize the existing environment for which the Project is being undertaken, to establish an understanding of the receiving environment, and to provide sufficient context to enable an understanding of how the Project may affect existing environmental conditions. Inclusion of existing conditions is limited to that which is necessary to assess the effects of the Project and support the development of mitigation measures, and monitoring and follow-up programs. Existing conditions consider the effects of past and current projects occurring within and outside of the PA.

Various methodologies were employed to obtain baseline conditions for each VC. Those methodologies are outlined for each VC in their corresponding subsection within Section 6 of this EIS.

5.7 Anticipated Project-Environment Interaction

Interactions between Project activities, and the VCs outlined in Section 5.3 of this EIS will either be direct or indirect.

Direct interactions between the Project and VCs are typically more obvious and can be logically expected based on a good understanding of Project activities, and existing physical, biophysical, and socio-economic conditions and characteristics of the Project area. Indirect interactions are less obvious and typically require an active pathway between Project activities and the VCs they are affecting. A pathway provides a link between a Project component or activity and VC, and facilitates the interaction and potential effect.

As an example, a direct effect may be the potential loss of a wetland through clearing, grubbing, and grading in preparation of surface mine construction. Clearing, grubbing, and grading may also decrease infiltration and therefore increase runoff from the site; resulting in a potential indirect effect on surface water quality and quantity. Poor surface water quality and quantity may then affect fish and fish habitat; this is an example of a VC acting as both the receptor of an effect and the pathway for an effect.

In order to determine the potential direct and indirect interactions between Project activities, and VCs the EA Study Team conducted the following:

- reviewed the anticipated components and activities required to construct, operate, and decommission the Project;
- selected VCs that may have the potential to directly or indirectly effected by Project activities;
- assessed the direct effects that Project activities may have on VCs;
- identified anticipated pathways between Project activities and any receiving VCs; and
- assessed the indirect effect that Project activities may have on VCs.

Once the direct or indirect interaction between Project activities and VCs is established, assessing the magnitude and duration of the effects of those interactions becomes much easier. Subsequently, evaluating mitigation measures to eliminate, reduce, or control the effects of those interactions becomes easier as well.

Accidents and malfunctions have been considered for every phase of the Project; however they are separated in the Project-VC interaction table to present the actual accidents and malfunctions that may occur during these phases.

Table’s 5.7-1, 5.7-2, and 5.7-3 present the anticipated Project component and activities, and VCs interaction for each Project area.

Interactions noted in Table 5.7-3 are specific to those that relate to new interactions as a result of the Beaver Dam project and not those that pre-exist at Touquoy as part of that site’s development, operation and reclamation.

Table 5.7-1 Potential Valued Components Interactions with Project Activities at Beaver Dam Mine Site

	Valued Components												
	Physical				Biophysical						Socio-economic		
	Atmospheric Environment	Geology, Soil, and Sediment Quality	Groundwater Quality and Quantity	Surface Water Quality and Quantity	Wetlands	Fish and Fish Habitat	Habitat and Flora	Terrestrial Fauna	Birds	SAR	Indigenous Peoples	Physical and Cultural Heritage	Health and Socio-economic Conditions
Site Preparation and Construction													
Clearing, Grubbing, and Grading	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Drilling and Rock Blasting	☑	☑	☑	☑	☑	☑		☑	☑	☑	☑	☑	☑
Topsoil, Till, and Waste Rock Management	☑	☑		☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Existing Settling Pond Dewatering	☑	☑	☑	☑	☑	☑	☑		☑	☑	☑		
Watercourse and Wetland Alteration	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Mine Site Road Construction, including lighting	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Surface Infrastructure Installation and Construction, including lighting	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Collection and Settling Pond Construction, including lighting	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Environmental Monitoring		☑	☑	☑	☑	☑		☑		☑	☑		
General Waste Management	☑	☑		☑	☑	☑	☑		☑	☑			
Operation and Maintenance													
Drilling and Rock Blasting	☑	☑	☑	☑	☑	☑		☑	☑	☑	☑		☑
Surface Mine Dewatering		☑	☑	☑	☑	☑	☑		☑	☑	☑		
Ore Management	☑	☑	☑	☑	☑	☑		☑	☑	☑	☑		
Waste Rock Management	☑	☑	☑	☑	☑	☑		☑	☑	☑	☑		
Surface Water Management		☑	☑	☑	☑	☑		☑	☑	☑	☑		☑
Petroleum Products Management	☑	☑	☑	☑	☑	☑	☑			☑	☑		☑
Site Maintenance and Repairs, including lighting	☑			☑					☑				☑
Environmental Monitoring	☑	☑	☑	☑	☑	☑	☑	☑		☑	☑		☑

Table 5.7-1 Potential Valued Components Interactions with Project Activities at Beaver Dam Mine Site

	Valued Components												
	Physical				Biophysical						Socio-economic		
	Atmospheric Environment	Geology, Soil, and Sediment Quality	Groundwater Quality and Quantity	Surface Water Quality and Quantity	Wetlands	Fish and Fish Habitat	Habitat and Flora	Terrestrial Fauna	Birds	SAR	Indigenous Peoples	Physical and Cultural Heritage	Health and Socio-economic Conditions
General Waste Management	☑	☑		☑	☑	☑	☑	☑	☑	☑			
Decommissioning and Reclamation													
Infrastructure Demolition	☑	☑		☑					☑				☑
Site Reclamation	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑		☑
Environmental Monitoring	☑	☑	☑	☑	☑	☑	☑	☑		☑	☑		☑
General Waste Management		☑		☑	☑	☑	☑	☑	☑	☑			☑
Accidents and Malfunctions													
Fuel and/or other Spills	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑		☑
Fire	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑		☑
Slope Failure	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑		☑	☑
Collection/Settling Pond Failure		☑	☑	☑	☑	☑	☑	☑	☑	☑	☑		☑
Unplanned Explosive Event	☑	☑		☑	☑	☑	☑	☑	☑	☑	☑		☑
Mobile Equipment Accident	☑	☑	☑	☑	☑	☑	☑	☑			☑	☑	☑

Table 5.7-2 Potential Valued Components Interactions with Project Activities along Haul Road

	Valued Components												
	Physical				Biophysical						Socio-economic		
	Atmospheric Environment	Geology, Soil, Sediment Quality	Groundwater Quality and Quantity	Surface Water Quality and Quantity	Wetlands	Fish and Fish Habitat	Habitat and Flora	Terrestrial Fauna	Birds	SAR	Indigenous Peoples	Physical and Cultural Heritage	Health and Socio-economic Conditions
<u>Site Preparation and Construction</u>													
Clearing, Grubbing, and Grading	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Drilling and Rock Blasting	☑	☑	☑	☑	☑	☑		☑	☑	☑	☑	☑	☑
Topsoil, Till, and Waste Rock Management	☑	☑		☑	☑	☑		☑	☑	☑	☑	☑	☑
Watercourse and Wetland Alteration	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Culvert and Bridge Upgrades and Construction/Removal	☑	☑		☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Haul Road Construction and Upgrades	☑	☑		☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Environmental Monitoring	☑	☑	☑	☑	☑	☑	☑	☑		☑	☑		☑
General Waste Management		☑		☑	☑	☑	☑	☑	☑	☑			
<u>Operation and Maintenance</u>													
Ore Transport	☑	☑	☑	☑				☑			☑		☑
Road Lighting	☑								☑		☑		
Haul Road Maintenance and Repairs	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑		☑
Environmental Monitoring	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑		☑
<u>Decommissioning and Reclamation</u>													
N/A – Decommissioning and Reclamation of the Haul Road is not expected.													

Table 5.7-2 Potential Valued Components Interactions with Project Activities along Haul Road

	Valued Components												
	Physical				Biophysical						Socio-economic		
	Atmospheric Environment	Geology, Soil, Sediment Quality	Groundwater Quality and Quantity	Surface Water Quality and Quantity	Wetlands	Fish and Fish Habitat	Habitat and Flora	Terrestrial Fauna	Birds	SAR	Indigenous Peoples	Physical and Cultural Heritage	Health and Socio-economic Conditions
<u>Accidents and Malfunctions</u>													
Fuel and/or other Spills	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑		☑
Fire	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑		☑
Haul Truck Accident	☑	☑	☑	☑	☑	☑	☑	☑			☑		☑

Table 5.7-3 Potential Valued Components Interactions with Project Activities at Touquoy Processing and Tailings Management Facility

	Valued Components												
	Physical				Biophysical						Socio-economic		
	Atmospheric Environment	Geology, Soil, and Sediment Quality	Groundwater Quality and Quantity	Surface Water Quality and Quantity	Wetlands	Fish and Fish Habitat	Habitat and Flora	Terrestrial Fauna	Birds	SAR	Indigenous Peoples	Physical and Cultural Heritage	Health and Socio-economic Conditions
<u>Site Preparation and Construction</u>													
Ore Processing Equipment Upgrades													
Tailings Line Alteration				☑									
Environmental Monitoring													
General Waste Management													
<u>Operation and Maintenance</u>													
Lighting of facility and mine site roads	☑								☑				
Ore Management and Processing	☑		☑	☑									
Tailings Management			☑	☑		☑			☑	☑			
Environmental Monitoring	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑		☑
General Waste Management			☑	☑	☑	☑	☑	☑	☑	☑			
<u>Decommissioning and Reclamation</u>													
Environmental Monitoring	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑		☑
<u>Accidents and Malfunctions</u>													
Fuel and/or other Spills	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑		☑
Fire	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑		☑
Mobile Equipment Accident	☑	☑	☑	☑	☑	☑	☑	☑			☑		☑

5.8 Effects Prediction

Potential Project-related effects are changes to the physical, biophysical, and/or human environment that are caused by Project activities. Interactions between VCs and Project activities are described in corresponding subsections within EIS Section 6 and form the basis for effects prediction. Establishment of interaction relationships between VCs and Project activities is described in EIS Section 5.7. Once these interaction relationships are established, determination of changes to VCs, defined as effects, as a result of Project activities is accomplished through:

- predicting adverse effects from Project activities, and evaluating the scope and scale of those effects;
- detailing mitigation measures triggered through regulatory requirements and/or best management practices to eliminate, reduce, or control the effect Project activities have on VCs;
- predicting cumulative effects from other projects occurring in the same spatial and temporal boundaries;
- determining residual effects remaining after mitigation measures are considered and cumulative effects are identified, to assess the significance of those effects in the context of each VC.

In order to determine if effects are significant prior to mitigation measures being implemented thresholds for determination of significance will be developed for each individual VC based on the following:

5.9 Mitigation Measures

A variety of mitigation measures are typically available to eliminate, reduce, or control the effect Project activities have on the environment. These measures range from procedures within standard industry best management practices for construction and operation, policies and practices communicated through training programs and management plans, and/or engineering controls incorporated into the final design. Given Atlantic Gold's experience with gold mining in the region, specifically the Touquoy Project, as well as past experience outlined in EIS Section 1.2.2, a number of mitigation measures were proactively incorporated into the Project design in order to eliminate, reduce, and/or control the effect of Project activities on the environment. Mitigation measures that are technically and economically feasible are considered for specific Project activity effects on VCs are described in corresponding subsections within EIS Section 6.

5.10 Residual Effects and the Determination of Significance

Residual effects are effects to VCs that are predicted to remain even after the implementation of mitigation measures. The process by which they are identified is as follows:

- Determine the potential interactions between VCs and Project activities and the effects those interactions will have;
- Asses effect of each mitigation strategy applied to the interactions; and

- Characterize the extent and nature of the remaining, residual effects after mitigation measures have been applied.

In order to identify if residual effects are significant or not, consideration of the magnitude, geographical extent, duration, frequency, reversibility, and ecological and social context is required. Table 5.10-1 provides a description of these effects characteristics and the varying degrees in which they can contribute to the significance of an effect.

Table 5.10-1 Characterization Criteria for Residual Environmental Effects

Characterization	Description	Definition of Qualitative Categories
Magnitude	Refers to the expected size and/or severity of an adverse effect relative to existing conditions on a valued component from Project activities after mitigation	**Negligible (N)** – no effect to valued component from Project activities **Low (L)** – an effect to VCs from Project activities but within the range of natural variability and does not affect population viability **Moderate (M)** – an effect to VCs from Project activities temporarily outside the range of natural variability and does not affect population viability **High (H)** – an effect to VCs from Project activities exceeding the range of natural variability and may affect long term population viability
Geographic Extent	Refers to the spatial extent of an adverse effect on a valued component from Project activities after mitigation	**Project Area (PA)** – direct and indirect effects from Project activities are restricted to the Project area **Local Assessment Area (LAA)** – indirect effects from Project activities are restricted to the local assessment area immediately adjacent to the Project area **Regional Assessment Area (RAA)** – effects from Project activities extend beyond the Project area and local assessment area to effect a more diffuse and longer range geographic area
Duration	Refers to the period of time an adverse effect on a valued component from Project activities will persist after mitigation	**Short-Term (ST)** – effects extend for a portion of the Project activities **Medium-Term (MT)** – effects extend through to the end of the Project activities Long-Term (LT) – effects extend beyond the end of the Project activities **Permanent (P)** – valued component unlikely to recover to baseline conditions
Frequency	Refers to the number of times an adverse effect on a valued component from Project activities	**Once (O)** – effects occur once **Sporadic (S)** – effects occur at irregular intervals throughout the Project

Table 5.10-1 Characterization Criteria for Residual Environmental Effects

Characterization	Description	Definition of Qualitative Categories
	will occur after mitigation	**Regular (R)** – effects occur at regular intervals throughout the Project **Continuous (C)** – effects occur continuously throughout the Project
Reversibility	Refers to the potential that a valued component will recover to baseline conditions once reclamation, restoration, compensation, and offset programs are considered	**Reversible (R)** – VCs will recover to baseline conditions before or after Project activities have been completed. **Irreversible (IR)** – effects to VCs are permanent and will not recover to baseline conditions
Ecological or Social Context	Refers to the general setting and influence of past and current human activity and the disturbance associated with that activity	**High Disturbance (HD)** – effect to valued component occurs within a high disturbed area that has significant human presence **Moderate Disturbance (MD)** – effect to valued component occurs within a moderately disturbed area that has periodic human presence **Low Disturbance (LD)** – effect to valued component occurs in a relatively pristine area that has infrequent human presence

In conjunction with the effects characteristics outlined in Table 5.10-1, each VC will be assigned a standard or threshold as described in Section 5.5 of this EIS to determine the significance of an effect caused by the Project.

5.11 Follow-up and Effects Monitoring

Follow-up is a process to verify the accuracy of predicted effects and determine the degree to which mitigation measures were successful in eliminating, reducing, or controlling those effects. Follow-up programs will be developed for the Beaver Dam Mine Project and will be developed through careful consideration of each VC after effects assessment has occurred. These programs are outlined for each VC in their corresponding subsection within Section 6 of this EIS.

Atlantic Gold will also evaluate the need for effects monitoring to ensure regulatory compliance. To supplement the effects monitoring, Atlantic Gold will also develop and implement environmental management and contingency plans to prevent or address accidents or malfunctions that have the potential to occur and produce unexpected effects throughout the life of the Project.

5.12 Effects of the Environment on the Project

Effects of the environment on the Project consider potential changes to the Project that may result from interactions with the environment. Project components and activities were reviewed for interaction with the natural environment and effects caused by variations in meteorological conditions from wind, ice, and extreme precipitation events, as well natural hazards like seismic activity. A significant effect on the Project from the environment would include, but not be limited to, the following:

- environmental conditions cause harm to Project personnel and/or the public;
- environmental conditions cause extended delays in construction or a shutdown of operations;
- environmental conditions damages infrastructure and compromises safety; and
- environmental conditions damages infrastructure to the point repair is not feasible.

The assessment of effects of the environment on the Project includes discussion regarding potential interactions, as well as details regarding planning, design, and construction strategies for reducing the likelihood of potential effects on the Project, thereby reducing the likelihood of accidents and malfunctions caused by the environment.

Project components and activities have been designed to consider the hazards and limitations imposed by the natural environment on the Project. The effects of the environment on the Project are discussed further in Section 7.0.

6. Environmental Effects Assessment

6.1 Atmospheric Environment

6.1.1 Rationale for Valued Component Selection

The atmospheric environment as a VC is comprised of three main components – air quality and climate change, noise and vibration, and ambient light.

Air quality is provincially regulated via the *Air Quality Regulations*, which protects the health of site workers. Air quality may also facilitate exposure of birds and fauna to particulate matter and contaminants through inhalation and/or ingestion. Climate change is known to be exacerbated by greenhouse gases (GHG), which will be created through the combustion of fuel during equipment operation. GHG's are the focus of provincial policies and regulations for the electricity sector; however, there exists no province-wide standard for greenhouse gas emissions.

Noise and Vibration is provincially regulated via the *Workplace Health and Safety Regulations* and the Pit and Quarry Guidelines, which protects the health of site workers and the general public at Project area boundaries, respectively. Changes to ambient noise levels and the presence of periodic vibrations have the potential to adversely affect fauna and birds by influencing migration and behavioral patterns.

Light level limits are not directly regulated through the provincial or federal regulatory regime. Changes (i.e. increases) to ambient light levels have the potential to adversely affect fauna and birds, as well as increase level of light pollution experienced by the general public or specific populations.

6.1.2 Baseline Program Methodology

Preliminary baseline particulate monitoring including total suspended particulate (TSP) and coarse particulate matter (PM_{10}) was conducted following United States Environmental Protection Agency (USEPA) sample methodology. A 24 hour sample was collected on an 8x10 filter utilizing a high volume sampler calibrated at a flow rate of approximately 40 cubic feet per minute (CFM). Pre-weighed filters were submitted to Maxxam Analytics in Sydney, NS, for final particulate weights. Concentrations of TSP and PM_{10} were calculated based on the final weight of particulate on the filters and the total volume of air sampled. Baseline particulate data was compared to the Nova Scotia Air Quality Standards (NSAQS).

Baseline ambient noise levels were evaluated using a Quest Sound Pro-DL Class 1 Precision Integrating sound level metre (serial number BGG040024). Data collected was evaluated against the provincial Pit and Quarry Guidelines as a reference. Sound level measurements were collected at several sample locations near the Beaver Dam mine site boundary and along the haul road, and one location on the Touquoy mine site, taking into consideration the nearest receptors and proposed mining equipment operational locations. Sound level measurements were not undertaken at any additional locations (such as at the nearest residence to the mine site). Ambient noise levels in the vicinity of the mine site and the haul road provide a more conservative baseline for comparative purposes.

A preliminary accoustical model was undertaken to provide an order of magnitude estimation of the estimated noise from the crushing operation and haul truck travel along the haul road. The model included a generic crushing operation, including a jaw crusher, cone crusher, and screener placed at grade, as these are typically the loudest sources of noise, and considered site-specific topography. The noise sources and topography were input into an industry standard acoustic model. Computer Aided Noise Abatement Acoustical Modeling Software (Cadna A), version 4.6, is based on the ISO 9613-2 standard "Acoustics – Attenuation of Sound During Propagation Outdoors - Part 2: General Method of Calculation." The Cadna A model is the industry standard for environmental noise modeling in Canada. The nearest receptor considered in the preliminary acoustical model included Beaver Lake IR 17, located approximately 5 km from the mine site and 3 km from the nearest point of the haul road.

An acoustic assessment was conducted as part of the 2007 Focus Report for the Touquoy mine site, focusing on sound emissions from noise sources identified at the facility and determining effects on sensitive receptors including; Kidston Day Camp (3 km from proposed open pit), the nearest full time resident (5 km north from proposed open pit) and the Scraggy Lake area. Sound level impacts were compared to the Nova Scotia Guidelines for Environmental Noise Measurement and Assessment. An estimated worst case facility sound level measurement for a 1 hour period was estimated for each receptor.

Table 6.1-1 Baseline Atmospheric Monitoring Locations

Sample Location	General Area	Sample Location Rationale
Location #1(2008)	Approx. 450 m south of Crusher Lake	On site boundary, near Waste Rock Storage area
Location #2(2008)	West end of Crusher Lake	500 m west of site boundary, northwest of Waste Rock Storage
Location #3(2008)	Near northwest end of Cameron Flowage, east of Mud Lake	North edge of site boundary, at pit and water diversion channel
AN#1	North of Cameron Flowage	North of Pit
AN#2	West end of Crusher Lake	400 m west of site boundary, northwest of Waste Rock Storage; in close proximity to Location #2 (2008)
AN#3	East southeast of proposed stockpile area and ROM Pad	400 m east of site boundary, in Stockpile and ROM Pad area.
AN#4	Near junction of Beaver Dam Mines Road and Hwy 224, approx. 1.35 km NNW of Hwy 224	Proposed crusher location
Beaver Dam Road	Near junction of Beaver Dam Mines Road and Hwy 224, approx. 300 m NNW of Hwy 224.	East end of Haul Road
Mooseland Road	130 m north of Mooseland Road, 560 m east of Haul Road	West end of Haul Road
Location 1 (Touquoy)	North of the proposed open pit	Proposed open pit location
Location 2 (Touquoy)	Northeast of the proposed open pit	Proposed open pit location
Location 3 (Touquoy)	South of the proposed open pit	Proposed open pit location
Location 4 (Touquoy)	North of the Touquoy Gold Mine on Mooseland Road	North of the Touquoy Gold Mine
Location 5 (Touquoy)	East of the Touquoy Gold Mine on Mooseland Road	East of the Touquoy Gold Mine

A light impact assessment was conducted for the Touquoy facility in 2007. The impacts of the proposed lighting installations were quantified and compared with guidelines published by The Institution of Lighting Engineers (ILE) in the document entitled “Guidance Notes for the Reduction of Obtrusive Light”. A background light study was conducted in August 2007. Post curfew measurements (after 11 pm) were conducted utilizing on a Skeonic L-358 flash meter. Measurements were taken in the EV mode, and converted into LUX values.

6.1.3 Baseline Conditions

6.1.3.1 Ambient Air Quality Standards

NSE regulates ambient air quality via the NSAQS. The maximum ground level concentrations for the parameters governed by this legislation are listed in Table 6.1-2.

Table 6.1-2 Nova Scotia Air Quality Standards

Contaminant	Averaging Period	Maximum Permissible Ground Level Concentration	
		µg/m3	pphm
Carbon Monoxide	1 hour	34,600	3,000
	8 hours	12,700	1,100
Hydrogen Sulfide	1 hour	42	3
	24 hours	8	0.6
Nitrogen Dioxide	1 hour	400	21
	Annual	100	5
Ozone	1 hour	160	8.2
Sulphur Dioxide	1 hour	900	34
	24 hours	300	11
	Annual	60	2
Total Suspended Particulate	24 hours	120	-
	Annual	70	-

Source: Nova Scotia Air Quality Regulations, Schedule A- Maximum Permissible Ground Level Concentration
pphm – parts per hundred million
µg/m^3 – micorgrams per meter cubed

The Canadian Ambient Air Quality Standards (CAAQS) are the driver for air quality management in Canada. Standards have been developed for fine particulate matter (PM2.5) and ozone (O3), and work has begun to develop standards for nitrogen dioxide (NO2) and sulphur dioxide (SO2). The CAAQS for PM2.5 and ozone were established in May 2013 as objectives under the Canadian Environmental Protection Act (CEPA) 1999 and replace the Canada-wide Standards for Particulate Matter and Ozone. The standards for 2015 and 2020 for the parameters governed by this legislation are listed in Table 6.1-3.

Table 6.1-3 Canadian Ambient Air Quality Standards

Contaminant	Averaging Period	Standards	
		2015	2020
Fine Particulate Matter (PM 2.5)	24 hours	28 µg/m3	27 µg/m3
	Annual	10 µg/m3	8.8 µg/m3
Ozone	8 hours	63 ppb	62 ppb

Source: Government of Canada, Environment and Climate Change Canada

6.1.3.2 Preliminary Local Ambient Air Quality

Preliminary baseline particulate monitoring was conducted at three locations for the Beaver Dam mine site in 2008, four locations for the Beaver Dam mine site in 2014, and two locations for the Haul Road in 2016. Baseline particulate monitoring was conducted at five locations for the Touquoy Gold Mine in 2007. Figures 6.1-1 and 6.1-2 display the locations during each monitoring event. The date and locations were determined based on meteorological forecasts for the sampling period, and the proximity to sensitive receptors and proposed mine features. A summary of the baseline conditions as measured analytically are presented in Table 6.1-4.

Table 6.1-4 Local Ambient Air Quality Program Results

Location	Date	Total Suspended Particulate Results (µg/m3)	Coarse Particulate Matter Results (µg/m3)
Location #1	June 5-6, 2008	19.4	9.1
Location #2	June 5-6, 2008	41.7	13.1
Location #3	June 5-6, 2008	12.9	7.1
AN#1	October 20-21, 2014	6.9	-
AN#2	October 20-21, 2014	4.6	-
AN#3	October 20-21, 2014	1.7	-
AN#4	October 20-21, 2014	3.9	-
Beaver Dam Road	September 7-8, 2016	9.7	-
Mooseland Road	September 7-8, 2016	5.8	-
Location # 1 (Touquoy)	January 3, 2007	11.6	-
Location # 2 (Touquoy)	January 3, 2007	10.5	-
Location # 3 (Touquoy)	January 4, 2007	14.0	-
Location # 4 (Touquoy)	January 4, 2007	16.1	-
Location # 5 (Touquoy)	January 4, 2007	14.4	-

Total suspended particulate concentrations ranged from 1.7 to 41.7 µg/m^3, with the higher value being obtained at Location #2 during monitoring in June 2008. Results for the coarse particulate matter (PM_{10}) concentrations ranged from 7.1 to 13.1 µg/m^3, with the higher value also obtained at Location #2 during monitoring in June 2008. This monitoring station was located in a recently clear cut area, which may have contributed to higher particulate levels in comparison to the other locations. This area was resampled in 2014 (AN-2). The 2014 results for that area were 4.6 µg/m^3, well below the NSAQS. For all other sample locations, baseline TSP and PM_{10} concentrations were below the NSAQS.

6.1.3.3 Regional Ambient Air Quality

Ambient air quality in Nova Scotia is monitored using a network of 13 sites operated by NSE and Environment and Climate Change Canada through the National Air Pollution Surveillance (NAPS) Network. Common air pollutants monitored at these stations include the following:

- SO2;
- total particulate matter (TPM);
- PM10;

- PM2.5;
- carbon monoxide (CO);
- O3; and
- Oxides of Nitrogen (NOx).

Data collected at these stations is used by NSE to report the Air Quality Index (AQI) and by Environment and Climate Change Canada to report the Air Quality Health Index (AQHI). There is no air quality monitoring station located in Beaver Dam and the closest NAPS monitoring stations are located in Dartmouth and Pictou, Nova Scotia. These two stations were chosen to represent ambient air quality in the general region of the PA due to their distance from the mine site compared to other available air quality monitoring stations (approximately 70 kilometres) and the amount of data available for review. These two stations have been operational since 2001 and have accumulated a significant dataset which provides a clear representation of the regional air quality. The two stations are located in more developed areas than the PA; however, this provides a more conservative depiction of regional air quality as the air quality in the PA is likely more pristine. A third station located in Alyesford, Nova Scotia was also selected which is farther away but located in an area with more similar land-use than the other two stations. Table 6.1-5 outlines the data for these three stations.

Table 6.1-5 Regional Ambient Air Quality at Nearest Monitoring Stations

Contaminant	Concentration		
	1 Hour Max	24 Hour Max	Annual Mean
Cherry Brook, Dartmouth, Nova Scotia			
Sulphur Dioxide (ppb)	23.5	3.0	0
Nitrogen Dioxide (ppb)	14.2	5.1	1
Ozone (ppb)	58	49.8	30
Nitrous Oxide (ppb)	13	1.5	0
Oxides of Nitrogen (ppb)	25.7	6.4	2
Fine Particulate Matter (PM2.5) (µg/m3)	27	16	5
91 Beeches Road, Pictou, Nova Scotia			
Nitrogen Dioxide (ppb)	18.7	6.5	1
Ozone (ppb)	61	44.3	25
Nitrous Oxide (ppb)	9	1.6	0
Oxides of Nitrogen (ppb)	20.9	8.0	2
Fine Particulate Matter (PM2.5) (µg/m3)	171	50	7
Mountain Brow Road, Kings County, Aylesford, Nova Scotia			
Nitrogen Dioxide (ppb)	3.6	1.7	N/A
Ozone (ppb)	66	59.5	33
Nitrous Oxide (ppb)	3	0.7	N/A

Contaminant	Concentration		
	1 Hour Max	24 Hour Max	Annual Mean
Oxides of Nitrogen (ppb)	5.4	1.9	N/A
Fine Particulate Matter (PM2.5) (µg/m3)	34	21	6
N/A Too few samples; average of available months is 0.			
Source: Environment and Climate Change Canada-Climate Data online-2015			

There were no exceedances of the NSAQS at the nearest stations for all contaminates. One exceedance of the CAAQS for $PM_{2.5}$ was reported for the Pictou station. The Beaver Dam mine site is located in a relatively undeveloped rural region of Nova Scotia with infrequent industrial operations that would affect air quality. As the NAPS monitoring stations are located in areas with local industry for Pictou and Dartmouth, measured concentrations of contaminants would likely be lower at Beaver Dam. They would likely be similar to the Alyesford monitoring station; however, since there is also forestry operations near Beaver Dam, concentrations at the Alyesford station may be lower.

6.1.3.4 Baseline Ambient Air Quality

To build upon the preliminary baseline sampling of select parameters and review of data collected from nearby NAPS stations that was completed as part of this EIS development, it is recommended that additional baseline sampling program be completed closer to the start of Project activities to obtain data that is more representative of baseline conditions in the area. Other activities in the area, such as forestry operations, have the potential to cause changes in air quality over the next five years prior to the start of the Project. Therefore, it is preferred to collect a full set of baseline air quality data (including total suspended particulates, $PM_{2.5}$, PM_{10}, SO_x, VOCs, and NO_x) prior to the start of construction. The data obtained as part of the baseline program reported herein provides a preliminary snapshot of air quality in the area of the mine site and haul road, and a general understanding of regional air quality.

A follow-up air monitoring program is currently underway at the Touquoy facility and is described in Section 6.1.7. Operational air data will be collected throughout the approved construction and operations phases of the Touquoy facility, which will provide insight into the effects of the Touquoy project on air quality prior to the processing of Beaver Dam ore.

6.1.3.5 Provincial and Federal Greenhouse Gas Limits

The NPRI is Canada's legislated and publicly accessible inventory of pollutant releases to air, water, and land. The NPRI is managed by Environment and Climate Change Canada and currently tracks over 300 substances and groups of substances. Under the authority of CEPA, owners or operators of facilities that meet the NPRI reporting requirements published in the Canada Gazette, Part I are required to report to the NPRI.

Accurate tracking of GHG emissions is an important part of assessing Canada's overall environmental performance. In March 2004, the Government of Canada announced the introduction of the Greenhouse Gas Emissions Reporting Program. All facilities that emit the equivalent of 50 kilotonnes or more of GHG's in carbon dioxide equivalent units (CO_2 eq) per year are required to submit a report. Facilities with emissions falling below the reporting threshold of 50 kilotonnes per year can voluntarily report their GHG emissions.

In 2009, NSE released the Greenhouse Gas Emissions Regulations, made under Section 112 of the Environment Act, establishing GHG emission caps on the electricity sector. These regulations apply to any facility located in the province of Nova Scotia that emits greater than 10 kilotonnes of CO_2 eq greenhouse gases in a calendar year. The facility owner must submit an annual report no later than March 31 of the following year.

The Beaver Dam mine site is located in a relatively undeveloped rural region of Nova Scotia with infrequent industrial operations that would contribute to GHG emissions. Existing GHG emissions would be generated primarily through recreational vehicle usage, local traffic, and limited forestry operations.

The Environment and Climate Change Canada document, "National Inventory Report 1990-2014: Greenhouse Gas Sources and Sinks in Canada – Part 3" (ECCC 2016b), the total GHG emissions from Nova Scotia were identified to be 16,600 kilotonnes CO_2e during 2014.

6.1.3.6 Ambient Noise

Ambient noise has been sampled at several representative locations. The key sensitive receptor in the area is the Beaver Lake IR 17; a satellite community of the Millbrook First Nation located approximately 5 km south of the Beaver Dam mine site. At its nearest point, the haul road route is approximately 3 km east of Beaver Lake IR 17. Other receptors in the area include seasonal camps and cottages along the Beaver Dam Mines Road. Receptors in other directions increases in distance up to 18 km over considerable changes in topography and are generally forested. Activities in these areas are ongoing and include recreational use (hunting, ATVs, etc). Camp Kidston, which operates only in the summer months, is located 3.5 km northeast of the Touquoy mine site. The nearest permanent full-time occupied residences are located approximately 5.8 km to the north of the open pit along Caribou Road. The next closest permanent residences to the Touquoy processing and tailings management facility are approximately 7.4 km to the northwest and 11.7 km to the southeast.

Noise data was recorded in A-weighted decibels (dBA) and presented as equivalent continuous noise level (L_{eq}) averaged over a time period and compared to Nova Scotia Environment criteria by time of day.

Table 6.1-6 Baseline Ambient Noise Levels

Monitoring Location	Date	Time	Average Leq Value	NSE Criteria
Location #1 Waste Rock Pile (near current secondary logging road)				
	June 16, 2008	12:00 – 18:59	50.5	0700-1900 ≤65 dBA
	June 16, 2008	19:00 – 22:59	47.3	1900-2300 ≤60 dBA
	June 16-17, 2008	23:00 – 06:59	48.1	2300-0700 ≤55 dBA
	June 17, 2008	07:00 – 18:59	55.1	0700-1900 ≤65 dBA
	June 17, 2008	19:00 – 22:59	47.2	1900-2300 ≤60 dBA
	June 17-18, 2008	23:00 - 06:59	**58.9**	2300-0700 ≤55 dBA
	June 18, 2008	07:00 – 18:59	**67.0**	0700-1900 ≤65 dBA
	June 18, 2008	19:00 – 22:59	**62.0**	1900-2300 ≤60 dBA
	June 18-19, 2008	23:00 - 06:59	**60.2**	2300-0700 ≤55 dBA
	June 19, 2008	07:00 – 09:51	59.1	0700-1900 ≤65 dBA
Location #2 Northwest of Mine Site (near secondary logging road)				
	June 11, 2008	11:30 – 18:59	32.0	0700-1900 ≤65 dBA
	June 11, 2008	19:00 – 22:59	31.0	1900-2300 ≤60 dBA
	June 11-12, 2008	23:00 - 06:59	30.2	2300-0700 ≤55 dBA
	June 12, 2008	07:00 – 18:59	41.6	0700-1900 ≤65 dBA
	June 12, 2008	19:00 – 22:59	38.1	1900-2300 ≤60 dBA
	June 12-13, 2008	23:00 - 06:59	31.6	2300-0700 ≤55 dBA
	June 13, 2008	07:00 – 18:59	51.1	0700-1900 ≤65 dBA
Location #3 North of Mine Site (wilderness location on topographic high)				
	June 6, 2008	15:00 – 18:59	34.7	0700-1900 ≤65 dBA
	June 6, 2008	19:00 – 22:59	29.2	1900-2300 ≤60 dBA
	June 6-7, 2008	23:00 - 06:59	28.4	2300-0700 ≤55 dBA
	June 7, 2008	07:00 – 18:59	34.3	0700-1900 ≤65 dBA
	June 7, 2008	19:00 – 22:59	30.0	1900-2300 ≤60 dBA
	June 7-8, 2008	23:00 - 06:59	31.0	2300-0700 ≤55 dBA
	June 8, 2008	07:00 – 18:59	34.2	0700-1900 ≤65 dBA
	June 8, 2008	19:00 – 22:59	35.3	1900-2300 ≤60 dBA
	June 8-9, 2008	23:00 - 06:59	33.2	2300-0700 ≤55 dBA
	June 9, 2008	07:00 – 14:40	38.1	0700-1900 ≤65 dBA
AN#1 Northeast of Mine Site (beside primary logging road)				
	October 20, 2014	13:26 – 18:59	45.8	0700-1900 ≤65 dBA
	October 20, 2014	19:00 – 22:59	30.9	1900-2300 ≤60 dBA
	October 20-21, 2014	23:00 - 06:59	30.0	2300-0700 ≤55 dBA
	October 20-21, 2014	07:00 – 11:58	32.4	0700-1900 ≤65 dBA
AN#2 Northwest of Mine Site (near secondary logging road)				
	November 20, 2014	11:36 – 18:59	33.6	0700-1900 ≤65 dBA

Table 6.1-6 Baseline Ambient Noise Levels

Monitoring Location	Date	Time	Average Leq Value	NSE Criteria
	November 20, 2014	19:00 – 22:59	34.6	1900-2300 ≤60 dBA
	Nov. 20-21, 2014	23:00 - 06:59	27.4	2300-0700 ≤55 dBA
	November 21, 2014	07:00 – 11:30	32.4	0700-1900 ≤65 dBA
AN#3 South of crusher location (along primary logging road)				
	November 20, 2014	11:13 – 18:59	36.4	0700-1900 ≤65 dBA
	November 20, 2014	19:00 – 22:59	38.5	1900-2300 ≤60 dBA
	Nov. 20-21, 2014	23:00 - 06:59	29.3	2300-0700 ≤55 dBA
	November 21, 2014	07:00 – 11:12	29.9	0700-1900 ≤65 dBA
Beaver Dam Road (Haul Road) (near Highway 224)				
	September 8, 2016	11:26 -18:59	44.2	0700-1900 ≤65 dBA
	September 8, 2016	19:00 – 22:59	43.1	1900-2300 ≤60 dBA
	September 8-9, 2016	23:00 - 06:59	42.5	2300-0700 ≤55 dBA
	September 9, 2016	07:00 – 11:59	44.6	0700-1900 ≤65 dBA
Mooseland Road (Haul Road) (south of proposed truck route)				
	September 20, 2016	15:42 – 18:59	31.1	0700-1900 ≤65 dBA
	September 20, 2016	19:00 – 22:59	34.1	1900-2300 ≤60 dBA
	Sept. 20-21, 2016	23:00 - 06:59	36.0	2300-0700 ≤55 dBA
	September 21, 2016	07:00 – 15:37	36.9	0700-1900 ≤65 dBA
Location #1 (Touquoy) (north of proposed open pit)				
	January 9, 2007	19:00 – 22:59	44.8	1900-2300 ≤60 dBA
	January 10, 2007	07:00 – 14:59	44.9	0700-1900 ≤65 dBA
	January 10, 2007	15:00 – 23:59	40.9	1900-2300 ≤60 dBA
	January 11, 2007	0:00 – 06:59	40.2	2300-0700 ≤55 dBA
	January 11, 2007	07:00 – 18:59	42.9	0700-1900 ≤65 dBA
	January 11, 2007	19:00 – 22:59	41.4	1900-2300 ≤60 dBA
	January 11-12, 2007	23:00 – 06:59	40.7	2300-0700 ≤55 dBA

Note: **Bold underline** - represent exceedances

Sound level measurements for all sample locations, except for Location #1 at the Beaver Dam mine site, met NSE Pit and Quarry criteria for all time intervals. Sample Location #1 was approximately 10 feet from a hauling road that was in use during the monitoring period contributing to elevated noise level readings. Typical sound sources would include recreational vehicles, traffic on local roadways and contribution from existing forestry operations. The degree to which these sources would influence the existing noise levels would vary depending on the time of day and season.

The noise monitoring locations were chosen to be representative receptors and also to understand the ambient noise at the mine site, along the haul road, and at the Touquoy mine site. Location #1, 2 and 3 and AN #1, 2, and 3 were placed so to understand the noise levels directly around the mine site. The Beaver Dam Mines Road site was chosen as the closest receptor to a dwelling to the

Mine site and the haul road. It is a surrogate for the Beaver Dam IR 17 location because the monitoring site would be more greatly affected by noise then the IR but would also record the same vehicle traffic from Highway 224 as would pass by the Beaver Dam IR. The IR is located approximately 3 km north of this monitoring location. The Mooseland Road monitoring location was chosen as a mid-point between the nearest dwelling on the Mooseland Road and the haul road. Location #1 at Touquoy was chosen to understand the noise levels directly around the Touquoy mine site and proposed open pit.

At the measurement locations around the mine site, based on the 2014 values (AN# 1,2,3) the average value is 33 dBA ±. The dominant noise sources noted are natural, including birds, the movement of leaves, and possibly the odd vehicle on a logging road. The measurement locations at Beaver Dam Mines Road and Mooseland Road would be mostly from natural sources. Mooseland Road measurements are comparable to the mine site. It is located on a little used gravel road. The Beaver Dam Mines Road is elevated and is near a paved highway with regular traffic. This road also passes through Beaver Dam IR and ambient sound will be the same as at the measured location.

At the Touquoy mine site, noise monitoring will be undertaken throughout the construction and operation of the facility if any complaints or concerns are received. To date, no noise complaints have been received or are anticipated.

6.1.3.7 Ambient Light

The Project Area is in a remote location. Ambient night time light conditions would be minimal and typical of an undeveloped rural area. The largest artificial light sources in the Project area are from the nearest residences of the Beaver Lake Indian Reserve, and the occasional all-terrain vehicle.

Light monitoring was not completed during the baseline studies as ambient night time light conditions are not anticipated to cause any effects on the nearest residences. The haul road will not be active at night and the Beaver Dam and Touquoy mine sites are located more than 5 km from the nearest residence.

As part of the 2007 Focus Report, a background light study was conducted. At all locations where measurements were taken, ambient light measurements were under exposed, indicating ambient light levels were too low to be measured.

6.1.3.8 Climate and Meteorological Information

The Project is located within the Eastern Nova Scotia climatic region, which is generally characterized by high rainfall and cool temperatures, due to the influence of the Nova Scotia Current. The nearest climate station with historical data is the Middle Musquodoboit climate station (ID# 8203535) operated by the Meteorological Service of Canada (MSC). The station is located approximately 15 km northwest of the mine site, near Middle Musquodoboit (45° 04’N, 63° 06’N).

The following is a summary of average climate conditions at the Middle Musquodoboit station, based on climate normals published by Environment and Climate Change Canada for the period from 1971 to 2000. Wind data is taken from the Halifax Airport climate station (MSC ID# 202250), which is located approximately 45 km west of the mine site. This is the closest station to the site for which wind data exists.

Mean annual total precipitation is 1370 mm, which includes 165 cm of average snowfall per year (165 mm water equivalent). Highest precipitation generally occurs in the months of October and November, with lowest precipitation in the month of February. Measurable precipitation occurs on an average of 164 days per year, with 141 days of measurable rainfall and 31 days of measurable snowfall.

The extreme one day rainfall for the station is 173 mm on August 15, 1971 and extreme one day snowfall is 70 cm on February 8, 1981.

Average temperature is 6.2 °C, with an average range from -6 °C to 18.1 °C. Temperature extremes can range from -34 °C to 35 °C. There is an average of 312 days per year with an average temperature above 0 °C.

Wind direction is generally westerly to northerly in January through April, southerly in May through October and again more westerly to northerly in November and December. Wind speeds average approximately 16.5 km/h, with an average range of 13.3 km/h in August to 18.5 km/h in March. Maximum hourly speeds can range from 56 km/h in August to 89 km/h in February, with maximum gusts of up to 132 km/h recorded.

6.1.4 Consideration of Consultation and Engagement Results

Key issues raised during public consultation and Mi'kmaq engagement relating to atmospheric environment include potential dust and noise from mining operations at Beaver Dam and trucking along the haul route. The change to the haul route alleviated these concerns with respect to passing by existing residences, especially concerns of Millbrook First Nation regarding its residents in Beaver Lake. Concerns about greenhouse gas emissions specifically associated with the trucking were also noted.

The results of the public consultation and Mi'kmaq engagement have been considered in the environmental effects assessment, including the Proponent's commitments on mitigation and monitoring measures and proposed compliance and effects monitoring programs, as well as the Proponent's broader commitment to ongoing public consultation and Mi'kmaq engagement. Specific to evaluating the effect on atmospheric environment, these are found within the following environmental effects assessment.

6.1.5 Effects Assessment Methodology

6.1.5.1 Boundaries

Spatial Boundaries

The spatial boundary used for the assessment of effects to the atmospheric environment, including the climate and greenhouse gas emissions, is the RAA. The spatial boundary used for the assessment of effects to the atmospheric environment, including air quality, noise, and ambient light, is the LAA. As the Project has the potential to cause direct and indirect effects to the atmospheric environment, as well as cumulative effects compounded spatially and temporally from other Projects, the RAA and LAA are the most appropriate spatial boundaries, respectively.

Temporal Boundaries

The temporal boundaries used for the assessment of effects to the atmospheric environment are the construction phase, operational phase, and decommissioning and reclamation phase.

Technical Boundaries

No technical boundaries were identified for the effects assessment of the atmospheric environment.

Administrative Boundaries

Air quality is provincially regulated via the Nova Scotia *Air Quality Regulations.* Noise and Vibration is provincially regulated via the *Workplace Health and Safety Regulations* and the Pit and Quarry Guidelines.

In 2009, NSE released the Greenhouse Gas Emissions Regulations, made under Section 112 of the Environment Act, establishing GHG emission caps on the electricity sector. These regulations apply to any facility located in the province of Nova Scotia that emits greater than 10 kilotonnes of CO_2 eq greenhouse gases in a calendar year. The facility may be required to report to the NPRI an inventory of pollutant releases to air, water, and land. There exists no province-wide standard for greenhouse gas emissions. Light level limits are not directly regulated through the provincial or federal regulatory regime.

Noise within the Project site is regulated by the province through the *Workplace Health and Safety Regulations*, which establishes the noise environment needed to maintain worker health. The Nova Scotia *Pit and Quarry Guidelines* (NSE 1999) indicate that noise levels at the boundaries of the project site are not to exceed the following levels:

- $L_{eq} \leq$ 65 dBA between 0700 to 1900 hours (daytime)
- $L_{eq} \leq$ 60 dBA between 1900 to 2300 hours (evening)
- $L_{eq} \leq$ 55 dBA between 2300 to 0700 hours (night-time, Sunday and statutory holidays)

The *Guidelines for Environmental Noise Measurement and Assessment* (NSE 1990) also require these noise levels to be met at locations where people normally live, work, or take part in recreation.

There may be other requirements for monitoring of the atmospheric environment through provincial approvals to be obtained prior to the start of the Project, specifically the Industrial Approval.

6.1.5.2 Thresholds for Determination of Significance

Dust and particulate, GHG emissions, noise, and ambient light will be generated throughout the life of the Project on the mine site and the haul road. Sources of Project -related noise may include construction and heavy machinery during the construction phase and heavy truck traffic during the construction and operational phases. The majority of mining operations will occur in the pit well below ground surface. GHG emissions will be generated during each phase of work from stationary and mobile fuel combustion sources. During the operation phase of the Beaver Dam mine, rock blasting using explosives was also considered as part of the GHG emissions that would be generated. Dust emissions are the primary atmospheric issue for the Beaver Dam mine site. Air-borne particulate matter will be generated during the construction and operation phases of the Project.

A significant adverse effect to the atmospheric environment at the Beaver Dam mine site is defined as a repeated or sustained release of contaminants from the mine site or haul road to the atmospheric environment that exceeds the NSE Maximum Permissible Ground Level Concentrations listed in the Nova Scotia *Air Quality Regulations* and that exceeds the Canadian Ambient Air Quality Standards for fine particulate matter and ozone. Table 6.1-7 and 6.1-8 lists these limits.

Table 6.1-7 Nova Scotia Air Quality Standards

Contaminant	Averaging Period	Maximum Permissible Ground Level Concentration	
		µg/m3	pphm
Carbon Monoxide	1 hour	34,600	3,000
	8 hours	12,700	1,100
Hydrogen Sulfide	1 hour	42	3
	24 hours	8	0.6
Nitrogen Dioxide	1 hour	400	21
	Annual	100	5
Ozone	1 hour	160	8.2
Sulphur Dioxide	1 hour	900	34
	24 hours	300	11
	Annual	60	2
Total Suspended Particulate	24 hours	120	-
	Annual	70	-

Source: Nova Scotia Air Quality Regulations, Schedule A- Maximum Permissible Ground Level Concentration
pphm – parts per hundred million
µg/m^3 – micorgrams per meter cubed

Table 6.1-8 Canadian Ambient Air Quality Standards

Contaminant	Averaging Period	Standards	
		2015	2020
Fine Particulate Matter (PM 2.5)	24 hours	28 µg/m3	27 µg/m3
	Annual	10 µg/m3	8.8 µg/m3
Ozone	8 hours	63 ppb	62 ppb

Source: Government of Canada, Environment and Climate Change Canada

A significant adverse effect to the atmospheric environment at the Beaver Dam mine site is also defined as repeated or sustained noise levels being emitted from the mine site or haul road that exceeds the NS Environment Pit and Quarry Criteria.

6.1.6 Project Activities Interactions and Effects

The key sensitive receptor in the area is the Beaver Lake IR 17; a satellite community of the Millbrook First Nation located approximately 5 km south of the Beaver Dam mine site. Seasonal camps and cottages are also located along the Beaver Dam Mines Road near Highway 224. Camp Kidston, which operates only in the summer months, is located 3.5 km northeast of the site. According to the Proponent, the nearest permanent full-time occupied residences are located approximately 5.8 km to the north of the open pit along Caribou Road.

The Touquoy facility is currently under construction. The primary effect of the continued use of the Touquoy facility is the continued generation of dust and noise due to haul truck traffic on the site, continued lighting of facilities, and continued generation of GHG emissions during the processing of Beaver Dam ore. There are no new or additional effects to the atmospheric environment anticipated to be caused by the processing of ore and the management of tailings from the Beaver Dam Mine Project, as no new construction or disturbance is required at the Touquoy facility related to the processing of Beaver Dam ore. The effects to the atmospheric environment previously described for the Touquoy facility in the EARD and Focus Report are presented in the sections below.

Table 6.1-9 Potential Atmospheric Environment Interactions with Project Activities at Beaver Dam Mine Site

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Clearing, grubbing, and grading in preparation of construction • Drilling and rock blasting in preparation of construction • Till and waste rock from site preparation transport and storage • Existing settling pond dewatering in preparation of construction • Watercourse and wetland alteration in preparation of construction • Mine site road construction • Lighting of construction areas • Surface infrastructure installation and construction • Collection and settling pond construction • General management of wastes derived from preparation and construction activities • Accidents and malfunctions to include fuel and other spills, forest fires, slope failure, an unplanned explosive event, and a mobile equipment accident
Operation and Maintenance	3-4 years	• Rock blasting to access and extract ore • Management of waste rock produced from crushing and preparing ore for transport • Petroleum products management • Site maintenance and repairs • Lighting of facilities and mine site roads

Table 6.1-9 Potential Atmospheric Environment Interactions with Project Activities at Beaver Dam Mine Site

Project Phase	Duration	Relevant Project Activity
		• Environmental monitoring of the atmospheric environment • General management of wastes derived from operation and maintenance activities • Accidents and malfunctions to include fuel and other spills, forest fires, slope failure, an unplanned explosive event, and a mobile equipment accident
Decommissioning and Reclamation	1-2 years	• Infrastructure Demolition • Site reclamation activities • Environmental monitoring • Accidents and malfunctions to include fuel and other spills, slope failure, and forest fires

Table 6.1-10 Potential Atmospheric Environment Interactions with Project Activities along Haul Road

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Clearing, grubbing, and grading in preparation of construction • Drilling and rock blasting in preparation of construction • Till and waste rock from site preparation transport and storage • Watercourse and wetland alteration in preparation of construction • Haul road construction and upgrades • Environmental monitoring of the atmospheric environment • Accidents and malfunctions to include fuel and other spills, forest fires, and a haul truck accident
Operation and Maintenance	3-4 years	• Ore transport • Road lighting • Haul road maintenance and repairs • Environmental monitoring • Accidents and malfunctions to include fuel and other spills, forest fires, and a haul truck accident
Decommissioning and Reclamation		N/A[1]
1 Decommissioning and Reclamation of the haul road is not expected. The haul road will be returned to owner for forestry industry		

Table 6.1-11 Potential Atmospheric Environment Interactions with Project Activities at Touquoy Processing and Tailings Management Facility

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Accidents and malfunctions to include fuel and other spills, forest fires, and mobile equipment accidents
Operation and Maintenance	3-4 years	• Ore management and processing • Lighting of facilities and mine site roads • Environmental monitoring of the atmospheric environment • Accidents and malfunctions to include fuel and other spills, forest fires, and mobile equipment accidents
Decommissioning and Reclamation	1-2 years	• Environmental monitoring • Accidents and malfunctions to include fuel and other spills, forest fires, and mobile equipment accidents

6.1.6.1 Dust and Particulate Emissions

6.1.6.1.1 *Beaver Dam Mine Site and Haul Road*

Dust emissions are the primary atmospheric issue for the Beaver Dam mine site and haul road. Air-borne particulate matter will be generated during construction and operation phases of the Project. Sources of Project -related particulate matter on the mine site and haul road may include the following:

- overburden removal;
- blasting;
- rock crushing;
- onsite heavy truck traffic;
- material loading;
- wind erosion of material storage piles;
- construction of mine site roads;
- construction of the haul road; and
- operation of other heavy machinery.

During operation, most of the dust will be generated at the mine site from crushing processes and trucking operations, and on the haul road from trucking operations. Given that there will be no residential buildings located near the proposed open pit area, increases in suspended particulate matter, although adverse, will not affect residents in that area.

Due to the proposed site operation and configuration, air emissions sources will be close to ground-level or below grade. There will likely be negligible impacts to the residential area due to the surrounding topography, the surrounding forested area, and the distance to the nearest residential area.

6.1.6.1.2 *Touquoy Processing Facility*

At the Touquoy mine site, dust will be generated at the crushing circuit and by service vehicles. Based on the 2007 Focus Report, dust generated during processing is anticipated to be minor. Air emissions generated from the Touquoy facility associated with the processing of Beaver Dam ore will include emissions generated from the processing plant, including the carbon reactivation furnace, the electrowinning cells, and the barring furnace (gold smelting), as well as mobile equipment sources. Air emissions will occur from the processing plant, including CO_2, ammonia, off-gassing of hydrogen cyanide, and nitrogen oxides. The contaminants are anticipated to be dispersed in the atmosphere to harmless concentrations immediately following release.

An Emissions Summary and Dispersion Modeling assessment was conducted to assess potential air releases to the atmosphere and their impact on the surrounding receptors. Based on the estimated maximum emissions scenario presented in the Focus Report, the predicted maximum ground level ambient air concentrations of all potential contaminants during full-scale operations of the Touquoy facility calculated from the air dispersion modeling were all well below applicable criterion at the three sensitive points of reception. Prevalent winds, ground cover and forested areas all will aid in further reducing emission levels. The Report demonstrates that the Touquoy facility operations under worse-case meteorological conditions will not adversely impact human health or the surrounding environment.

6.1.6.2 Greenhouse Gas Emissions

The primary sources of GHG emissions were considered for each phase of the Project (construction, operation, and decommissioning). The primary sources of emissions from each work phase are stationary and mobile fuel combustion sources. These fuel combustion GHG-specific emissions include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). During the operation phase of the Beaver Dam mine, GHG emissions that would be generated from explosives used in rock blasting were also considered. For rock blasting, the explosive considered in the assessment was ammonium nitrate with fuel oil (ANFO), which is an explosive used by Atlantic Gold at other project sites. Under ideal conditions, the sole GHG emission from this explosive is CO_2, though small amounts of CH_4 and N_2O may also form as a result of the combustion. For the purposes of these emission estimates, it has been assumed the ANFO will be combusting under ideal conditions, with the primary CO_2 emissions being included only.

Other key assumptions used as part of the GHG emission estimates include:

- Sources of stationary and mobile combustion are operational 24 hours a day during the mine operation phase and during the construction and decommissioning phases would be limited to 16 hours. Down-time for equipment is assumed to occur up to 10 days out of a year due to weather conditions. This is a conservative estimate as additional downtime would be required for equipment maintenance/repair during this period.

- The energy ratings have been assumed for the equipment/vehicles that are proposed to be used for the Project at this time. As the Project details become more defined, these energy ratings can be better developed. The energy ratings have been used, along with projected hours of operation and number of equipment/vehicles, to project fuel use at the site. The exception to this are the hauling mobile combustion sources fuel use estimates, which are based on an assumed daily average number of trips from the Beaver Dam mine site to the Atlantic Gold Touquoy Project site and an assumed fuel efficiency for the hauling trucks.
- Projected fuel use totals have been increased an additional 20% to account for combustion inefficiencies in the mobile and stationary combustion sources.
- The ANFO use during the operation phase has been estimated by Atlantic Gold based on prior mining experience at similar sites to be approximately 2000 tonnes/year.

6.1.6.2.1 *Beaver Dam Mine Site and Haul Road*

The projected GHG emission estimates for the life of the Beaver Dam Mine Project, based on the available information, are presented in Table 6.1-12. It is expected that as the phase milestone activities approach, the information driving the emissions estimates below can be refined based on known rather than projected data.

Table 6.1-12 Estimated GHG Emissions (Beaver Dam mine site and Haul Road)

Phase	Period	GHG	Phase Emissions	
			(tonnes)	Tonnes CO_2e
Construction	2021	CO2	11,954.5	12,176.0
		CH4	0.7	
		N2O	0.7	
Operation	2022-2026	CO2	121,634.2	124,178.7
		CH4	6.7	
		N2O	8.0	
Decommissioning	2027-2029	CO2	35,863.5	36,527.9
		CH4	2.1	
		N2O	2.1	
Note: CO2e – Carbon dioxide equivalents				

GHG emissions from Nova Scotia reported in 2014 were 16,600 kilotonnes CO_2e (ECCC 2016b). Based on the Project GHG assessment, in an average full year of operation of the Project (most GHG-intensive phase), the site would emit 30.34 kilotonnes CO_2e - approximately 0.18% of the reported 2014 GHG total for Nova Scotia. All phases for the life-of-Project would represent approximately 1% of the provincial one year total.

6.1.6.2.2 *Touquoy Processing Facility*

At the Touquoy Processing Facility, GHG emissions will be generated from light and mobile fuel combustion sources, as well as emissions from the processing plant during the period of full-scale operations (2022 to 2026). The equipment used in the processing plant was not considered in the emissions estimates, as all other equipment are electricity based (indirect GHG emission sources). The projected GHG emission estimates for the life of the Beaver Dam Mine Project at the Touquoy facility, based on the available information, are presented in Table 6.1-13. It is expected that as Touquoy Processing Facility begins processing Touquoy ore, the information driving the emissions estimates below can be refined based on known rather than projected data.

Table 6.1-13 Estimated GHG Emissions (Touquoy Processing Facility)

Phase	Period	GHG	Phase Emissions	
			(tonnes)	Tonnes CO_2e
Operation	2022-2026	CO2	32,895.2	33,947.5
		CH4	1.2	
		N2O	3.4	

Note: CO2e – Carbon dioxide equivalents

GHG emissions from Nova Scotia reported in 2014 were 16,600 kilotonnes CO_2e (ECCC 2016b). Based on the Project GHG assessment, in an average full year of processing of the Beaver Dam ore at the Touquoy facility (most GHG-intensive phase), the Touquoy processing facility would emit 6.79 kilotonnes CO_2e - approximately 0.04% of the reported 2014 GHG total for Nova Scotia. All processing for the life-of-Project would represent approximately 0.20% of the provincial one year total.

6.1.6.2.3 *Overall Project*

In an average full year of operation of the Beaver Dam mine (most GHG-intensive phase), including operation of the mine site, hauling of ore, and the processing of ore at the Touquoy facility, the Project facilities would emit 37.13 kilotonnes CO2e - approximately 0.22% of the reported 2014 GHG total for Nova Scotia. All operation, hauling, and processing for the life-of-Project would represent approximately 1.25% of the provincial one year total.

6.1.6.3 Noise Emissions

6.1.6.3.1 *Beaver Dam Mine Site and Haul Road*

Sources of Project-related noise on the haul road may include heavy machinery and truck traffic during the construction and operational phases. The nearest permanent residential dwelling (5 km) is located in the Beaver Lake IR 17. This is located approximately 5 km south of the mine site and is separated from the mine site by forest and two topographic ridges. These ridges block direct views from the houses to all work areas. The surface mine is located in a topographic depression and the crusher is in a more elevated position; however, distance to any sensitive receptors would mitigate any effects. The likelihood of any dwellings in this rural area being occasionally impacted by sound from the mine site is very low. The majority of mining operations will occur in the pit well below ground surface thereby provide excellent noise shielding. The nearest point of the haul road to the Beaver Lake IR 17 is approximately 3 km. The haul road is currently in use for forestry activities and the activities on the haul road related to the Mine site will be similar in nature. The likelihood of the IR being impacted by sound from the haul road is also very low.

Further assessment of baseline monitoring before construction, during construction, and during mining operations will be conducted to ensure impacts are below the NSE guidelines and the Health Canada noise guidance which allows for an incremental increase in the percentage of highly annoyed population in the community to remain below 6.5% at sensitive receptors. Based on typical mining scenarios in rural regions of Nova Scotia, the predicted sound levels at the mine boundaries have the potential to exceed the noise goals during both daytime and evening operations. However, at 1 km from the mine the sound levels may be at or below the noise goals, with sound levels dropping towards the ambient levels with distance. Blasting events may provide a slight spike in the sound levels at distance for a brief period of time at the same time of day (daytime) once or twice a week.

Predicted noise impacts were estimated using a preliminary accoustical model. The model was undertaken to provide an order of magnitude estimation of the predicted noise from the crushing operation and haul truck travel along the haul road. Site specific topography and mine layout was used for the model; however, all mobile sources, equipment, and open pit operations were not included. The results are cumulative for the equipment that was evaluated. Additional monitoring could be undertaken in the future if required as part of the IA process.

Based on a review of the preliminary acoustical model, noise impacts from the mine site and the haul road, as a result of crushing and haul operations only, are below the most conservative NSE criteria of 55 dbA (applicable for the hours of 23:00 to 7:00) at a radius of approximately 500 metres from the mine site and the haul road. Beaver Lake IR 17 is located approximately 5 kilometres from the mine site and 3 km from the nearest point of the haul road. Based on the estimated noise levels related to crushing and hauling provided by the acoustical model, there will be no noise impacts on the Beaver Lake IR 17 due to operations on the mine site or the haul road. A predicted noise contour plot is provided on Figure 6.1-1.

6.1.6.3.2 *Touquoy Processing Facility*

At the Touquoy mine site, the primary source of noise during the processing of Beaver Dam ore will be the crushing circuit, CIL circuit, and service vehicles. All other processing equipment is located within the processing building. As indicated in the EARD, the maximum sound generated at the processing plant is 80 dBA, which attenuates to the background of 40 dBA over a distance of 500 metres. Based on an additional acoustic assessment conducted as part of the Focus Report, predicted values at the sensitive receptors ranged from 34.6 dBA to 42.3 dBA. All estimated values are below the NSEL daytime sound level criteria on the dBA scale. Predicted noise levels at Scraggy Lake and Camp Kidston were approximately 2 dBA greater than daytime values measured in the baseline study. The predicted sound level at the farthest sensitive receptor from the proposed site was 34.6 dBA, which is below the baseline value measured.

6.1.6.4 Light Levels

6.1.6.4.1 *Beaver Dam Mine Site and Haul Road*

Lights will be installed in active construction and operational areas and on mine site facilities, including mine site roads. Lights will be operational at all times to provide for a safe working environment. Vehicle headlights moving around the site as well as entering and exiting the site will also be introduced. Temporary lighting systems (including portable lights) may be used during construction to illuminate specific areas and ensure the safety of staff.

Increased light may cause disturbance or displacement of species, while attracting other species, or general behavioral changes (DaSilva, Valcu and Kempenaers, 2015). For those species which may be attracted to lights, lights may increase potential for direct mortality of these species or may increase habitat suitability by supplementing their source of prey. Birds may become attracted to or disoriented by open pit lighting at night, particularly during periods of migration, which could lead to mortality (Jones and Francis, 2003). Light can also alter habitat quality and sleep/wake cycles for terrestrial fauna within the immediate vicinity of the PA. This may decrease efficiency of nocturnal hunters. Some opportunistic wild species may be attracted to the site as a result of increased access and available food sources (natural prey or anthropogenic food sources), potentially increasing interactions between site personnel and wildlife.

Ambient night-time light levels on the mine site are not anticipated to affect the Beaver Lake IR 17 community given the distance to the mine. The Beaver Lake IR 17 is located approximately 5 km south of the mine site and is separated from the mine site by forest and two topographic ridges. These ridges block direct views from the houses to all work areas. The surface mine is located in a topographic depression and the crusher is in a more elevated position; however, distance to any sensitive receptors would mitigate any effects. The lighting effects would have a lower impact although it could be more widely experienced, especially if moisture or particulate matter are present in the atmosphere. The resulting halo of light above the mine might be seen from many locations. Although evident and given the rural setting of the site, it is not considered that it would cause any significant visual impact, due to a combination of large viewing distance and the screening effects of topography and vegetative cover.

Ambient night-time light levels are not anticipated to increase along the haul road as a result of the Project. Ore will be hauled to the Touquoy Processing and Tailings Management Facility for approximately 12 to 16 hours per day during the operational phase. Highway truck traffic will not generally be present on the haul road during night-time hours.

6.1.6.4.2 Touquoy Processing Facility

As part of the 2007 Focus Report, a light impact assessment was conducted for the Touquoy mine site and included three sensitive receptors – Camp Kidston, located approximately 3 km from the open pit, the nearest full time residence, approximately 5 km from the open pit, and the Scraggy Lake area. Based on the light impact assessment report, the calculated light levels at each sensitive receptor were significantly below the limits recommended by the ILE guidelines. Illuminance values ranged from 5.87 E-02 lux to 2.94 E-01 lux, which are well below the Post Curfew value of 1 lux.

Background ambient light was not measurable; therefore, project light sources during full-scale operations at the Touquoy mine site will have an impact on the existing environment. However, predicted Touquoy project sources will be well below ILE guidelines at all three sensitive receptors and in essence will have illuminance values less than that produced by a full moon. The surrounding forest area will further inhibit the spread of light. Impacts from proposed lighting sources will therefore not negatively impact migrating birds, native species, or other sensitive receptors. Additionally, during the processing of Beaver Dam ore, ambient light sources at the Touquoy facility are anticipated to be less than those used during full-scale operations.

6.1.7 Mitigation and Monitoring

The operational activities at the Touquoy facility during the Beaver Dam Mine Project are limited to processing of ore and management of tailings. Existing mitigation and monitoring requirements applicable to this site per the IA are anticipated to continue throughout the life of the Beaver Dam Mine Project.

6.1.7.1 Dust and Particulate Emissions

Prior to the start of construction, a baseline ambient air quality monitoring program will be undertaken at select locations on the Beaver Dam mine site and along the haul road. Air quality monitoring is currently ongoing at the Touquoy mine site and will continue throughout the construction and operations phase. The data collected will be used to better understand potential effects and refine mitigation and monitoring requirements prior to the processing of Beaver Dam ore.

The control of dust from the mining operations will focus on provision of moisture control measures, such as spraying with water as required. In-pit operations will not generally have much direct off-site impact, but could contribute to general dust levels at critical times if not controlled. The crushed ore stockpile at Touquoy will be covered to minimize wind and rain erosion; stockpiles will not be covered at the Beaver Dam mine site and may contribute to dust. Dust control requires careful and consistently applied mitigation measures throughout the Project, if non-compliant or nuisance levels are to be avoided. The proposed mitigation measures for various process components are outlined below. These are similar to measures routinely used at most other Nova Scotia surface mine operations that result in air quality guidelines being met and issues minimal.

To minimize dust produced by on-site (Beaver Dam and Touquoy) and haul road vehicle operations, the following may be used as required:

- Wet suppression controls on unpaved surfaces;
- Hardened surfaces where practical;
- Speed reduction;
- Use of large haul vehicles so as to minimize trip frequency;
- Covering of haul trucks to minimize dust during transportation between the mine site and the Touquoy facility

Wind erosion from elevated waste rock piles containing finely divided material can be a major source of dust at mine sites. Slopes on inactive stockpiles will be stabilized with mulching and / or vegetation, where appropriate. Waste rock piles will be sprayed with water as necessary to minimize fugitive dust.

Blasting, on site vehicle operations, crushing, and wind erosion from waste rock piles all could contribute to increased particulate levels. Several mitigation measures will be utilized to reduce particulate emissions.

- Wet suppression controls on unpaved surfaces
- Speed reduction to keep dust levels at minimum
- Stabilized slopes on inactive stockpiles of either mulch or vegetation for waste rock stockpiles.

Additional TSP monitoring would be required to measure the full effects on suspended particulate matter once mine operations begin. An audit program of the same sampling sites originally chosen for the baseline monitoring can be implemented. Additional sites may be required beyond those used in baseline.

Atlantic Gold may vary the mitigations depending on specifics of the situation so long as the dust levels are in accordance with the regulatory approval. Atlantic Gold is aware that the proposed Project will be regulated by the Nova Scotia Air Quality Regulations and will ensure that operations meet these requirements.

The existing IA requirements for the Touquoy facility related to air and particulate emissions include:

- Six monitoring locations for dust near property boundaries, which will be sampled during dry periods for total suspended particulate;
- Mitigative measures, such as application of dust suppressants during dry periods, will be implemented to control fugitive dust emissions;
- Emissions from the processing plant must be in compliance with Schedule A of the Air Quality Regulations and the IA specific requirements for maximum ground level concentrations at ground level / site boundary, as well as stack emission limits, e.g., total particulate matter and opacity;
- An air emission source program is in place to monitor emissions for compliance; if non-compliance occurs, an emissions reduction plan must be prepared and implemented to achieve compliance;
- Air emissions control systems are in place in accordance with the plans submitted to NSE prior to operations; this will be operated in accordance with the operation and maintenance manual, including regular inspections; and
- Records of monitoring and any corrective actions will be submitted to NSE in the annual report; however, any non-compliance is identified to NSE in timely fashion as per the IA.

6.1.7.2 GHG Emissions

Atlantic Gold will take steps to minimize GHG emissions associated with the Beaver Dam Mine Project, through activities such as reducing engine idling, where possible, and considering the use of more fuel efficient vehicles and equipment. GHG emissions will also be minimized through the adoption of good maintenance practices, including undertaking regular maintenance as specified by suppliers. A review of emissions will be completed on an annual basis. Atlantic Gold will seek to use Best Available Practices (BAP) that will evolve over time.

Mitigation measures at the Touquoy processing facility are also described in the Air Quality Management Plan that was completed as part of the IA application for this facility. These mitigation measures include regular equipment maintenance, choosing more efficient equipment and vehicles, using high luminous efficiency lamps and electronic ballasts, and reduction of vehicle travel distances and idling where possible. These mitigation measures are anticipated to continue throughout the life of the Beaver Dam Mine Project.

6.1.7.3 Noise Emissions

Atlantic Gold will control operations and equipment to ensure noise levels are kept within recommended limits for surface mining operations. Mine site noise will be periodically measured at the property boundaries to ensure regulation levels are not exceeded. A sampling program to collect representative noise level data will be undertaken prior to when surface clearing and construction begins.

Noise from the equipment and lack of effective mufflers is a source of noise. Procurement of equipment that meets best practices in terms of noise emissions, and regular maintenance of the equipment will reduce noise levels. Site workers will be trained to ensure equipment is used in ways that minimize noise and are maintained regularly. As part of the workplace health and safety program, noise monitors may be attached to workers form time to time to measure and monitor noise exposure over a shift.

The majority of mining operations will occur in the pit well below ground surface thereby provide excellent noise shielding and blasting will be restricted to daytime hours, per the NSE Pit and Quarry Guidelines. Additionally, traffic on the haul road will generally be restricted to 12 to 16 hours per day during the operational phase. This will minimize noise along the haul road during evening hours. The forest surrounding the mine and the haul road will also provide a dampening effect to any noise generated. Topography and distance from receptors will also provide contribute to a reduction of project generated sound at a distance.

This combination of measures will adequately mitigate potential noise impacts. Noise monitoring will be conducted, especially during construction and early in the operational phase to verify compliance with regulatory approvals. The results will be submitted to regulators as requested. The mitigation procedures may vary as long as noise levels are in accordance with the regulatory approval.

Additionally, noise monitoring would be completed during each blasting event, as required by the conditions of any approval and as is typically the practice in Nova Scotia. Blast monitoring generally involves noise and vibration monitoring during each blasting event, and includes monitoring at the nearest residence to the mine site, which in this case would be at Beaver Lake IR 17.

Under the existing IA for the Touquoy facility, maximum sound levels are prescribed at property boundaries for days, evenings and weekends and monitoring is only required when requested by NSE in response to a complaint or concern. Mitigation measures will be implemented as necessary where sound levels are a concern, i.e., causing annoyance, and monitoring demonstrates exceedances. To date, no noise complaints have been received or are anticipated.

The Project is expected to have a low adverse residual impact on ambient noise.

6.1.7.4 Light Levels

The use of lights will be limited to the amount necessary to ensure safe operation, with the recognition that excessive lighting can be disruptive to wild species. Light pollution will be reduced by installing downward-facing lights on site infrastructure and mine site roads, as well as at the Touquoy facility. Wherever possible, motion-sensing lights will be installed to ensure lights are not turned on when they are not necessary. Only direct and focused light will be used for worker safety.

Bird collisions with Project lighting and subsequent mortality are expected to be rare but if it occurs, it would not likely have significant effects on migrating bird populations. Efforts will be made to reduce the effect of lighting on migrating birds. Practices will be reviewed on an annual basis for BAPs, including illumination. No additional monitoring is recommended for the mine site related to night-time light levels.

Ambient night-time light levels are not anticipated to increase along the haul road as a result of the Project; therefore no additional mitigation or monitoring is required on the haul road. Ore will be hauled to the Touquoy Processing and Tailings Management Facility for approximately 12 to 16 hours per day during the operational phase. Highway truck traffic will not generally be present on the haul road during night-time hours.

Table 6.1-14 Mitigation and Monitoring Program for the Atmospheric Environment

Project Activity	Mitigation Measures	Mitigation and Monitoring Program
Site Preparation and Construction	Dust and Particulate Reduction	• Wet suppression controls on unpaved surfaces • Maintain hardened surfaces where practical • Speed reduction on the mine site to keep dust levels to a minimum • Air quality monitoring including dust and ambient-air monitoring, as required at select baseline sampling locations as directed in the EPP and by regulators • Covering of haul trucks to minimize dust during transportation along the haul route

Table 6.1-14 Mitigation and Monitoring Program for the Atmospheric Environment

Project Activity	Mitigation Measures	Mitigation and Monitoring Program
	GHG Emissions Reduction	• Limited engine idling where possible • Implementing fuel efficiencies where possible • Regular maintenance of equipment • Review of emissions on an annual basis and seek to use BAPs that evolve over time.
	Noise Minimization	• Regular maintenance of equipment • Highway truck traffic will not generally be present on the haul road during night-time hours. • Noise monitoring program will be undertaken, including blasting noise monitoring and periodic noise level monitoring at the property boundaries • Additional monitoring may be required as directed by regulators.
	Night-Time Light Minimization	• Reduce light pollution on site by installing downward-facing lights on site infrastructure and mine site roads. • Wherever possible, install motion-sensing lights to ensure lights are not turned on when they are not necessary. • Only use direct and focused light when needed for worker safety.
Operation and Maintenance	Dust, Particulate, and Processing Emissions Reduction	• Wet suppression controls on unpaved surfaces • Maintain hardened surfaces where practical • Speed reduction on the mine site to keep dust levels to a minimum • The crushed ore stockpile at Touquoy will be covered to minimize wind and rain erosion • Air quality monitoring including dust and ambient-air monitoring, as required at select baseline sampling location locations as directed in the EPP and by regulators • Additional TSP monitoring will be undertaken once mine operations begin, including an audit program of the same sampling sites originally chosen for the baseline monitoring • Monitoring of six locations for TSP near the Touquoy property boundaries during dry periods • Covering of haul trucks to minimize dust during transportation between the mine site and the Touquoy facility • Processing emissions at the Touquoy facility must be in compliance with Schedule A of the

Table 6.1-14 Mitigation and Monitoring Program for the Atmospheric Environment

Project Activity	Mitigation Measures	Mitigation and Monitoring Program
		Air Quality Regulations and IA specific requirements • Complete an air emission source program at the Touquoy facility
	GHG Emissions Reduction	• Limited engine idling where possible • Implementing fuel efficiencies where possible • Regular maintenance on equipment • Review of emissions on an annual basis and seek to use BAPs that evolve over time.
	Noise Minimization	• Regular maintenance of equipment • Highway truck traffic will not generally be present on the haul road during night-time hours. • Noise monitoring program will be undertaken, including blasting noise monitoring and periodic noise level monitoring at the property boundaries of the Beaver Dam mine site. • Monitoring at the Touquoy site will be conducted when requested by NSE. • Additional monitoring may be required as directed by regulators.
	Night-time Light Minimization	• Reduce light pollution on site by installing downward-facing lights on site infrastructure and mine site roads. • Wherever possible, install motion-sensing lights to ensure lights are not turned on when they are not necessary. • Only use direct and focused light when needed for worker safety. • Highway truck traffic will not generally be present on the haul road during night-time hours • Review of practices relative to haul road operation on an annual basis for BAP including illumination
Decommissioning and Reclamation	Dust and Particulate Reduction	• Speed reduction on the mine site to keep dust levels to a minimum • Stabilized slopes will be maintained on the waste rock stockpile • Air quality monitoring including dust and ambient-air monitoring, as required at select baseline sampling location locations as directed in the EPP and by regulators • Covering of haul trucks to minimize dust during transportation on the haul route

Table 6.1-14 Mitigation and Monitoring Program for the Atmospheric Environment

Project Activity	Mitigation Measures	Mitigation and Monitoring Program
	GHG Emissions Reduction	• Limited engine idling where possible • Implementing fuel efficiencies where possible • Regular maintenance on equipment • Review of emissions on an annual basis and seek to use BAPs that evolve over time.
	Noise Minimization	• Regular maintenance of equipment • Noise monitoring program will be undertaken, including blasting noise monitoring and periodic noise level monitoring at the property boundaries • Additional monitoring may be required as directed by regulators.

6.1.8 Residual Effects and Significance

The predicted residual environmental effects of Project development and production on the atmospheric environment are assessed to be adverse, but not significant. The overall residual effect of the Project on the atmospheric environment is assessed as not likely to have significant adverse effects after mitigation measures have been implemented.

Table 6.1-15 Residual Environmental Effects for the Atmospheric Environment

Project - VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
Clearing and grubbing	Equipment maintenance, dust suppression	A	L	PA	ST	R	IR	LD	Disturbance	Not Significant
Heavy machinery operation	Equipment maintenance, dust suppression	A	L	PA	MT	R	R	LD	Disturbance	Not Significant
Vehicle activity for transportation of personnel and operating supplies	Equipment maintenance, dust suppression	A	L	PA	MT	R	R	LD	Disturbance	Not Significant
Construction and commissioning of support infrastructure	Equipment maintenance, dust suppression	A	L	PA	ST	R	R	LD	Disturbance	Not Significant
Haul road construction and alteration	Equipment maintenance, dust suppression	A	M	PA	ST	R	IR	MD	Disturbance	Not Significant
Blasting and drilling of in-situ rock	Equipment maintenance, dust suppression	A	M	PA	MT	R	IR	LD	Disturbance	Not Significant
Haul truck activity	Equipment maintenance, haul truck operation <24 hours per day to minimize noise disturbances	A	M	PA	MT	R	IR	MD	Disturbance	Not Significant
Primary crushing of ore	Equipment maintenance, dust suppression	A	M	PA	MT	R	R	LD	Disturbance	Not Significant
Waste rock, till, and ore stockpiles	Dust suppression, stabilization of slopes	A	L	PA	LT	R	R	LD	Disturbance	Not Significant
Operation of machinery through all phases	Minimize GHG emissions through limited engine idling,	A	M	PA	MT	R	IR	MD	Disturbance	Not Significant

Table 6.1-15 Residual Environmental Effects for the Atmospheric Environment

Project - VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
	implementing fuel efficiencies, and conducting regular maintenance on equipment. GHG emissions at Touquoy will be minimized through mitigation measures.									
Open pit and other mine site lighting	Minimize lighting wherever possible (downward facing lighting, utilize motion-sensor lights)	A	L	PA	MT	R	R	MD	Attraction and disorientation of birds	Not Significant

Legend (refer to Table 5.10-1 for definitions)

Nature of Effect	Geographic Extent	Frequency	Ecological and Social Context
A Adverse	PA Project Area	O Once	LD Low Disturbance
P Positive	LAA Local Assessment Area	S Sporadic	MD Moderate Disturbance
	RAA Regional Assessment Area	R Regular	HD High Disturbance
Magnitude		C Continuous	
N Negligible	Duration		
L Low	ST Short-Term	Reversibility	
M Moderate	MT Medium-Term	R Reversible	
H High	LT Long-Term	IR Irreversible	
	P Permanent		

6.1.9 Proposed Compliance and Effects Monitoring Program

As the Project moves forward, monitoring programs will proceed to gather pre-construction air quality and noise baseline data. Monitoring programs will continue during construction and operation to verify baseline conditions and to determine the effects of the Project on the atmospheric environment. Table 6.1-14 summarizes the mitigation and monitoring activities that will be completed throughout the life of the Project. The details of the monitoring programs will be determined in consultation with regulatory agencies and will be described in the application for an IA for the site operations following the EA process. High level detail is needed in this application and would be subject to review by NSE and other agencies. An Environmental Management System (EMS) and Environmental Protection Plan (EPP) will be developed as part of the Project implementation that will confirm the responsibility and system of accountability for the compliance and effects monitoring program. The objectives of the atmospheric environment monitoring programs are to:

- Verify effects predicted in the EIS;
- Confirm the continuing effectiveness of mitigation measures;
- Identify the need for any new mitigation measures; and
- Confirm compliance with regulatory approvals and requirements.

Atmospheric environment monitoring programs will include the following, as identified in Table 6.1-14, as well as additional monitoring required by regulatory agencies:

- Air quality monitoring including dust and ambient-air monitoring, as required at select baseline sampling locations and review of ongoing air monitoring data for the Touquoy facility. Additional TSP monitoring will be required once mine operations begin;
- Review of GHG emissions on an annual basis and review of GHG emissions throughout the operation of the Touquoy processing facility;
- Noise monitoring program will be undertaken, including blasting noise monitoring and periodic noise level monitoring at the property boundaries and any additional monitoring required; and
- Review of practices relative to haul road operation on an annual basis.

6.2 Geology, Soil, and Sediment Quality

6.2.1 Rationale for Valued Component Selection

Geology, soil, and sediment as a VC is centered on: the potential for acid rock drainage (ARD) to be produced during exposure of Halifax Group or sulphide-bearing bedrock to oxygen and surface water runoff; and the potential for contamination of soil and sediment from mining activities. ARD is provincially regulated through the *Sulphide Bearing Material Disposal Regulations*.

Soil and sediment quality may facilitate exposure of birds, fauna, and fish to contaminants through ingestion. Exposure of soil from Project activities may increase the potential for siltation of watercourses from surface water runoff. Contaminated soil and sediment is provincially regulated via the *Contaminated Sites Regulations*.

6.2.2 Baseline Program Methodology

Discrete location sediment grab samples were collected on July 21, 2016 from nine locations throughout the Beaver Dam mine site to obtain baseline sediment quality data prior to site preparation and construction activities beginning. The rationale for each sample location is provided in Table 6.2-1.

Table 6.2-1 Baseline Sediment Locations for Beaver Dam Mine Site

Sample ID	Sample Location	Sample Location Rationale
SED1	Downstream of Cameron Flowage	To characterize sediment quality downstream and south of Project activities
SED2	Upstream of Cameron Flowage	To characterize sediment quality upstream and north of Project activities
SED3	Down-gradient of till stockpile and outflow from Crusher Lake	To characterize sediment quality downstream of Project activities
SED4	Down-gradient of till stockpile	To characterize sediment quality downstream of Project activities
SED5	Down-gradient of till stockpile into Wetland 20	To characterize sediment quality downstream of Project activities
SED6	Downstream of Cameron Flowage	To characterize sediment quality downstream and south of Project activities
SED7	Downstream of facilities, ore storage and crushing facilities	To characterize sediment quality downstream and south of Project activities
SED8	Downstream of waste rock pile	To characterize sediment quality downstream of waste rock storage
SED9	Downstream of waste rock pile	To characterize sediment quality downstream of waste rock storage

The purpose of this program was to establish a baseline for comparison of sediment quality before and after site activities commence. Each sample was collected as a grab sample and analyzed for metals, including mercury (Hg).

Analytical results were compared to the CCME Sediment Quality Guidelines for the Protection of Aquatic Life (Freshwater Interim Sediment Quality Guidelines (ISQG)/ and Probable Effect Level (PEL)). The CCME PEL guidelines represent the maximum authorized concentrations in a grab sample, above which adverse effects are expected to occur frequently. ISQGs represent the maximum total concentration in surficial sediments (i.e. top 5 centimetres).

The Touquoy site was previously subjected to a sediment quality investigation that consisted of the collection of sediment samples from ten locations on the Touquoy site and surrounding area watercourses in January 2007. Three of these locations had organic substrate not suitable for chemical analysis for soils. The results of the previous Touquoy investigation are summarized below.

Historical till and soil geochemical regional data is available from the DNR. The documents entitled Compilation of Seabright Resources Inc. Till and Soil Geochemical Data over the Meguma Terrane (NSDNR 2006) and Till Geochemical Survey over Mainland Nova Scotia (NSDNR 2006a) were reviewed. Till samples were collected from 1986 to 1989 by Seabright Resources Inc. and Seabright Explorations Inc., and from 1977 to 1982 by the Department of Regional Economic Expansion and Nova Scotia Department of Mines, respectively. Samples were submitted for chemical analysis of select metals. The results of the historical till investigations are summarized below.

6.2.3 Baseline Conditions

6.2.3.1 Physiography, Geomorphology, and Topography

The Beaver Dam Mine Project is located in the Eastern Ecoregion of the Acadian Ecozone. Ecoregions express macroclimate as a distinctive ecological response to climate through soils and vegetation (Neily et al. 2005).

The Eastern Ecoregion is underlain by quartzite and slate of the Meguma Group with granitic intrusives. A variety of landforms are found in this ecoregion, including rolling till plains, drumlin fields, extensive rockland, and wetlands. The bedrock is highly visible in those areas where the glacial till is very thin, exposing the ridge topography.

Ecoregions are further subdivided into Ecodistricts, which reflect macro elements of the physical and biological attributes of ecosystems which will ultimately influence biodiversity. The three primary Project locations are spread across the further subdivided Eastern Interior and Eastern Drumlin Ecodistricts. The Eastern Interior Ecodistrict is generally characterized by highly visibly bedrock where glacial till is very thin, exposing the ridge topography. Where till is thicker, ridged topography is masked and thick softwood forests occur. There are a few drumlins and hills scattered throughout the Ecodistrict and fine textured soils are derived from slates. The Eastern Drumlin Ecodistrict is underlain by Meguma Group greywacke and slate, blanketed by fine-textured till derived from these underlying and adjacent rocks. Drumlins are derived from carboniferous rocks from the north, as well as material from the Cobequid Hills and Pictou-Antigonish Highlands. Figure 6.2-1 displays Ecodistricts in the area of the Project.

The Beaver Dam mine site is in an area of low topographic relief at 140 masl with scattered drumlins reaching 165 to 175 masl and Cameron Flowage channeling through a topographic low of 130 masl. Drainage is to the southeast along a number of poorly drained streams, shallow lakes, and wetlands.

6.2.3.2 Soils and Sediment

The soils of Halifax County have developed almost entirely from glacial drift and, in most cases, mirror the distribution of underlying rock formations. This is particularly true for course-textured materials derived from granite and quartzite. Finer-textured materials were transported more readily by glaciers and typically accumulated in drumlin or drumlin-like mound deposits (Hilchey et al 1963).

Sediment is derived from the movement of soils and in some instances bedrock materials being transported by water to areas frequented by water. Soil and bedrock quality is therefore a good indicator of what sediment quality is in the absence of anthropogenic activities that could affect sediment directly. Sediment quality for the Beaver Dam site, haul road and Touquoy site are discussed below.

The Beaver Dam mine site is primarily composed of soils belonging to the Bridgewater and Halifax series. Surface soil and subsoils of the Bridgewater series are typically medium-textured brown shaley loam over yellowish-brown shaley loam with parent material consisting of olive shaley loam till derived from Precambrian slates. Surface soil and subsoils of the Halifax series are typically brown sandy loam over yellowish sandy loam with parent material consisting of olive to yellowish-brown stony sandy loam till derived from quartzite. These soils correlate to the NS Forest Soil Type – ST2, common in upland forests throughout the province. Soil depths to sea horizon are typically up to 18 inches. No mapping currently exists to depict soil depth by horizon.

These soils are suitable for reclamation in a forest environment at the site. Soils recovered from the area of the pit will be used elsewhere throughout the site.

The haul road is composed of a variety of soil types, but is dominated by the Danesville, Halifax, and Gibraltar series. Surface soil and subsoils of the Danesville series are typically dark grayish brown sandy loam over yellowish-brown sandy loam with parent material consisting of dark brown sandy loam till derived from quartzite. Surface and subsoils of the Gibraltar series are typically brown sandy loam over strong brown sandy loam with parent material consisting of pale brown coarse sandy loam till derived from granite.

The Touquoy processing and tailings management facility is primarily composed of soils belonging to the Danesville series.

Figure 6.2-2 displays regional soil cover as mapped by Hilchey (1963).

Regional till and soil data was reviewed and compared to CCME Soil Quality Guidelines (SQG) for the Protection of Environmental and Human Health for industrial property use. A review of the regional till samples collected by Seabright Resources Inc. and Seabright Exploration Inc. in the *Compilation of Seabright Resources Inc. Till and Soil Geochemical Data over the Meguma Terrane* identified that 98 samples were located in the vicinity of the PA. Results available for review included samples analyzed for arsenic, tungsten, gold, and antimony. Data was not provided for additional metals that may have been analyzed. The results indicate that arsenic concentrations were identified to be above the CCME soil quality guidelines of 12 mg/kg in 29 of the 98 samples antimony concentrations were identified to be below the CCME SQG of 40 mg/kg in all samples collected. Tungsten results were presented with negative concentrations; therefore they are not included in the discussion. There are no applicable guidelines for gold.

A review of the till samples collected by the Department of Regional Economic Expansion and Nova Scotia Department of Mines in the *Till Geochemical Survey over Mainland Nova Scotia* identified three soil samples in the vicinity of the PA. Samples were identified to have been collected from Lake Alma, MacGreggor Lake, and River Lake, located adjacent to the Haul Road. Results available for review included samples analyzed for silver, copper, lead, zinc, cadmium, nickel, cobalt, iron, manganese, calcium, magnesium, mercury, arsenic, molybdenum, uranium, tin, tungsten, and barium. Based on a review of the analytical results, copper was identified to exceed the CCME SQG of 91 mg/kg in one of three samples collected. No other parameters were identified to exceed the CCME SQGs, where they exist.

6.2.3.2.1 Sediment Quality – Beaver Dam Mine Site

Single surficial sediment grab samples were collected on July 21, 2016 from nine locations throughout the Beaver Dam mine site and surrounding watercourses to obtain baseline sediment quality data prior to site preparation and construction activities beginning. A summary of parameters exceeding the CCME freshwater sediment quality guidelines (where they exist) is provided in Table 6.2-2. All concentrations of metals are total values.

Arsenic levels above CCME probable effects level (PEL) and interim sediment quality guidelines (ISQG) were identified at Sediment locations 1 to 7. Arsenic (As) is a naturally occurring element in the earth's crust and is found throughout the environment. In a gold mining area rich in arsenic mineralization (e.g. arsenopyrite), high As concentrations indicate naturally occurring arsenic. Arsenic concentrations in soils around mine sites have been reported as high as 4,700 ppm in areas where historic mining activity has concentrated As levels in mill waste. High levels of As in the 100s of mg/kg in sediments indicate that further monitoring is warranted. It is noted that the action of movement in water concentrates many higher density materials including metals such as the naturally occurring arsenic.

Cadmium and copper concentrations above CCME ISQG were identified at Sediment location 5. The sample did not exceed CCME PEL for cadmium or copper.

Mercury concentrations above CCME ISQG were identified at Sediment location 3. The sample did not exceed CCME PEL. Mercury (Hg) occurs in all types of rocks and is present in the atmosphere as metallic mercury vapours and as volatized organic mercury compounds. Mercury is used in the chlor-alkali industry, pulp and paper manufacture, thermometers, electrical equipment, dental amalgams and some medicinal compounds. Mercury-based pesticides are no longer used and no mining of mercury in Canada has occurred since 1975. Mercury was detected at all sites between concentrations of 0.014 to 0.31 mg/kg. These concentrations make further monitoring warranted but there are no indications of historic tailings at the Beaver Dam site and no indications that mercury was used in any of the historic stamp mill or other crude processing of ore.

Table 6.2-2 Summary of Sediment Quality for Beaver Dam Mine Site

Sample ID	Sample Location	Parameters Exceeding CCME Freshwater Sediment Quality Guidelines (ISQG)	Parameters Exceeding CCME Freshwater Sediment Quality Guidelines (PEL)
SED1	Downstream of Cameron Flowage	Arsenic	Arsenic
SED2	Upstream of Cameron Flowage	Arsenic	Arsenic
SED3	Down-gradient of till stockpile and outflow from Crusher Lake	Arsenic, Mercury	Arsenic

Table 6.2-2 Summary of Sediment Quality for Beaver Dam Mine Site

Sample ID	Sample Location	Parameters Exceeding CCME Freshwater Sediment Quality Guidelines (ISQG)	Parameters Exceeding CCME Freshwater Sediment Quality Guidelines (PEL)
SED4	Down-gradient of till stockpile	Arsenic	Arsenic
SED5	Down-gradient of till stockpile into Wetland 20	Arsenic, Cadmium, Copper	Arsenic
SED6	Downstream of Cameron Flowage	Arsenic	Arsenic
SED7	Downstream of facilities, ore storage and crushing facilities	Arsenic	Arsenic
SED8	Downstream of waste rock pile	N/A	N/A
SED9	Downstream of waste rock pile	N/A	N/A

Full analytical results compared to CCME Freshwater Sediment Quality Guidelines are included in **Appendix C**.

The existing topsoil and overburden are considered suitable for use in the rehabilitation of disturbed areas Topsoil will be stockpiled in two locations during construction and used to facilitate re-vegetation at the end of the surface mine life and, when practical, during operation. Organic debris (roots, stumps, brush) will also be stockpiled and mulched to provide biomass for reclamation. All disturbed areas, most notably the waste rock and till storage piles, will be reclaimed with topsoil and growing medium to a depth matching the native surroundings.

6.2.3.2.2 Sediment Quality - Touquoy Site

A sediment quality investigation at the Touquoy site consisted of the collection of ten sediment samples from the site and surrounding area watercourses in January 2007. Three of these locations had organic substrate not suitable for chemical analysis for soils. A summary of the analytical results from the Touquoy site is presented below. Arsenic levels above the CCME probable effects level (PEL) were found at Sediment Sites 1, 2, 3, 5, 6, 7 and 8. Sites 1, 6, 7 and 8 are above the existing open pit or in a different catchment. All the locations exceed the CCME interim sediment quality guideline (ISQG).

Only Station 5 (0.81 mg/kg) exceeds the ISGQ (0.6 mg/kg) but not the PEL (3.5 mg/kg) limits for cadmium. Station 9 along the shore of Scraggy Lake is close to the ISGQ at 0.58 mg/kg.

Sediment at Site 3, 5, 6 and 10 exceed the ISQG limit (35 mg/kg Pb) for lead but not the PEL limit (91.3 mg/kg Pb). Sediment from the shore at Scraggy Lake far exceeded both limits at 1100 mg/kg

Pb. Such a high concentration in a relatively pristine area appears to be anomalous and suggests that the lake requires further investigation.

Mercury was found at Sites 3 and 9 at concentrations above the ISQG limit (0.17 mg/kg), and at Site 2 (0.52 mg/kg) above the PEL (0.48 mg/kg). It was detected at all sites between concentrations of 0.02 to 0.16 mg/kg.

The concentration of zinc was relatively consistent across all sites. Site 9 at 150 mg/kg was elevated above the ISQG limit of 123.0 mg/kg, but well below the PEL of 315.0 mg/kg.

Cyanide was included in the analysis to monitor for its presence once the mine is operating. Cyanide is naturally present in some foods and in certain plants and seeds such as peach pits. Cyanide is contained in over 800 plant species, some foods and a great number of microorganisms, cigarette smoke and the combustion products of synthetic materials such as plastics. In manufacturing, cyanide is used to make paper, textiles, and plastics. It is present in the chemicals used to develop photographs. Cyanide salts are used in metallurgy for electroplating, metal cleaning, and removing gold from its ore. Cyanide gas is used to exterminate pests and vermin in ships and buildings. If accidentally ingested (swallowed), chemicals found in acetonitrile-based products that are used to remove artificial nails can produce cyanide. Cyanide was not used in the previous milling operations.

Cyanide was detected at low levels in Sites 5, 9 and 10, all sites that are well removed from the open pit. It was below the detection limit of 0.5 mg/kg at all other sites.

6.2.3.3 Surficial Geology

Surficial geology in the area is described on geology maps (Stea et al., 1992) as consisting of stony till plains and drumlins with minor organic deposits. Till is typically 2-20 m thick and primarily comprised of a stony and sandy matrix material derived from local bedrock sources, while drumlin facies are typically 4-30 m thick and siltier due to erosion and incorporation of older till units by glaciers. Figure 6.2-3 displays regional surficial geology.

6.2.3.4 Bedrock Geology

Nova Scotia can be divided into two distinct metallogenic terranes; the Avalon Terrane to the north and the Meguma Terrane to the south (Keppie et. al., 2000). These two terranes developed independently until they were juxtaposed along the Cobequid-Chedabucto Fault Zone during the mid-Devonian Acadian Orogeny. Figure 6.2-4 displays the regional bedrock geology.

The Beaver Dam gold deposit is located in an area of Nova Scotia dominated by the Meguma Supergroup, which is divided into the 5,600 m thick basal greywacke Goldenville Group and the 4,400 m thick overlying, finer grained, argillite Halifax Group. These sediments were uplifted and deformed into a series of tightly folded subparallel northeast trending anticlines and synclines during the Acadian Orogeny. The Meguma Group rocks are metamorphosed from greenschist to amphibolite (staurolite) facies and were intruded by granites and minor mafic intrusions by circa 370 Ma (Smith and Kontak, 1996). Mineralization at the Beaver Dam Property occurs in the north-dipping southern limb of an overturned anticline with gold hosted both within quartz veins and disseminated through the intervening inter-bedded argillite and greywacke. It is the quartz vein hosted gold mineralization augmented by disseminated style mineralization in or near anticline hinges that forms the basis of a geological model associated with the ongoing exploration and development of the Beaver Dam gold deposit.

Regional and site specific drilling has encountered bedrock materials that consist mainly of metamorphosed sedimentary rocks of the Goldenville Group. Atlantic Gold reviewed the historic drill core from within the deposit and has recently supplemented this with additional resource delineation drilling and core sample analysis of in situ ore and waste rock.

Analysis of the historical in situ ore and waste rock for ARD potential was completed in accordance with the Sulphide Bearing Material Disposal Regulations. Results indicated that the majority of the deposit is acid consuming; however there are areas that will require specific handling and disposal due to the sulphur content and therefore the acid generating potential. Recent analysis of six ore and waste rock samples showed that two exceeded the 0.4% sulphur threshold and thus an acid generating potential in excess of the acid consuming potential. The remainder of the samples had net acid consuming potential. Refer to Table 6.2-3 for results. During construction and operations, regular testing of rock will be conducted for acid generating potential at a rate to be determined by NSE. This is typically approximately 1 sample per 100,000 tonnes of rock generated.

Table 6.2-3 Acid-Base Accounting Summary

SAMPLE	OA-VOL08				OA-ELE07	OA-VOL08	S-IR08	S-IR07	S-GRA06a	OA-VOL08m				
	FIZZ RATING	MPA	NNP	NP	pH	Ratio (NP:MPA)	S	Sulphide S	S	FIZZ RATING	NP	MPA	NNP	Ratio (NP:MPA)
	Unity	tCaCO3 /1Kt	tCaCO3 /1Kt	tCaCO3 /1Kt	Unity	Unity	%	%	%	Unity	tCaCO3 /1Kt	tCaCO3 /1Kt	tCaCO3 /1Kt	Unity
BD014-015	1	31.3	-17	14	8.7	0.45	1	0.88	0.02	1	8	31.3	-23	0.26
BD190-040	1	18.1	-5	13	9.1	0.72	0.58	0.55	0.02	1	9	18.1	-9	0.5
BD156-009	1	9.1	5	14	9.4	1.54	0.29	0.28	0.02	1	9	9.1	0	0.99
BD156-075	1	0.6	23	24	9.4	38.4	0.02	0.02	0.01	1	22	0.6	21	35.2
BD157-070	3	5	153	158	9.2	31.6	0.16	0.14	0.02	3	145	5	140	29
BD034-066	2	8.1	36	44	9.3	5.42	0.26	0.28	<0.01	2	35	8.1	27	4.31
BD160-039	1	5	4	9	9.5	1.8	0.16	0.14	0.02	1	8	5	3	1.6
BD005-054	1	21.3	-4	17	8.2	0.8	0.68	0.65	0.03	1	14	21.3	-7	0.66
BD049-042	4	4.4	544	548	8.4	125.25	0.14	0.1	0.03	4	521	4.4	517	119.09
BD179-045	3	0.3	197	197	9.1	630.4	0.01	<0.01	0.01	4	160	0.3	160	512
BD179-149	2	5.6	22	28	9.2	4.98	0.18	0.12	0.03	2	24	5.6	18	4.27
BD110-050	2	2.5	46	48	9.5	19.2	0.08	0.07	0.01	2	37	2.5	35	14.8
BD006-012	2	9.7	49	59	9.3	6.09	0.31	0.3	0.01	2	59	9.7	49	6.09
BD169-044	1	0.3	14	14	9.3	44.8	0.01	0.01	0.02	1	12	0.3	12	38.4
BD169-088	2	0.6	40	41	9.2	65.6	0.02	0.04	0.01	2	35	0.6	34	56
BD011-015	1	0.6	15	16	8.9	25.6	0.02	0.02	0.01	1	11	0.6	10	17.6
BD183-070	1	0.6	17	18	9.3	28.8	0.02	0.03	<0.01	1	13	0.6	12	20.8
BD183-148	2	2.5	60	62	9.2	24.8	0.08	0.04	0.06	2	60	2.5	58	24
BD109-040	2	<0.3	26	26	9.2	166.4	<0.01	<0.01	0.01	2	19	<0.3	19	121.6
BD187A-010	1	5.6	6	12	9.1	2.13	0.18	0.13	0.06	1	9	5.6	3	1.6
BD040-007	1	11.6	-2	10	9.2	0.86	0.37	0.38	0.01	1	6	11.6	-6	0.52
BD190-043	1	15.6	-6	10	9.3	0.64	0.5	0.51	0.02	1	7	15.6	-9	0.45

Table 6.2-3 Acid-Base Accounting Summary

SAMPLE	OA-VOL08				OA-ELE07	OA-VOL08	S-IR08	S-IR07	S-GRA06a	OA-VOL08m				
	FIZZ RATING	MPA	NNP	NP	pH	Ratio (NP:MPA)	S	Sulphide S	S	FIZZ RATING	NP	MPA	NNP	Ratio (NP:MPA)
	Unity	tCaCO3 /1Kt	tCaCO3 /1Kt	tCaCO3 /1Kt	Unity	Unity	%	%	%	Unity	tCaCO3 /1Kt	tCaCO3 /1Kt	tCaCO3 /1Kt	Unity
BD156-108	2	1.9	15	17	9.3	9.07	0.06	0.05	0.01	2	10	1.9	8	5.33
BD157-031	2	11.9	16	28	9.4	2.36	0.38	0.36	0.05	1	17	11.9	5	1.43
BD157-033	2	51.9	-12	40	9	0.77	1.66	1.48	0.04	2	31	51.9	-21	0.6
BD034-045	2	4.1	48	52	9.3	12.8	0.13	0.1	0.01	2	47	4.1	43	11.57
BD160-089	2	1.3	34	35	8.9	28	0.04	0.04	0.01	2	30	1.3	29	24
BD160-140	1	9.1	1	10	9.5	1.1	0.29	0.24	0.06	1	7	9.1	-2	0.77
BD085-046	1	24.4	-14	10	8.7	0.41	0.78	0.7	0.06	1	7	24.4	-17	0.29
BD049-140	1	0.9	10	11	9.4	11.73	0.03	0.04	<0.01	1	8	0.9	7	8.53
BD179-043	1	<0.3	14	14	9.3	89.6	<0.01	<0.01	0.01	1	9	<0.3	9	57.6
BD179-170	1	9.4	3	12	9.3	1.28	0.3	0.3	0.02	1	7	9.4	-2	0.75
BD006-013	1	38.1	-27	11	8.9	0.29	1.22	1.19	0.05	1	6	38.1	-32	0.16
BD169-136	3	3.8	189	193	9.1	51.47	0.12	0.12	<0.01	3	177	3.8	173	47.2
BD169-187	1	2.8	8	11	9.5	3.91	0.09	0.08	0.02	1	7	2.8	4	2.49
BD011-123	1	31.6	-19	13	8.8	0.41	1.01	0.94	0.02	1	8	31.6	-24	0.25
BD183-132	3	1.9	82	84	9	44.8	0.06	0.05	0.01	3	53	1.9	51	28.27
BD109-019	1	7.8	5	13	8.7	1.66	0.25	0.17	0.01	1	9	7.8	1	1.15
BD066-091	2	6.3	15	21	8.9	3.36	0.2	0.15	0.01	1	11	6.3	5	1.76
BD186-149	2	8.4	13	21	9.1	2.49	0.27	0.22	0.03	1	11	8.4	3	1.3

6.2.3.5 Seismic Activity

The North American Plate has a stable interior but along the edges more seismic activity is likely to occur. Eastern Canada is part of the stable interior; however; unlike the subduction zone on the west coast of North American where plates are colliding, crustal stresses on the east coast are more difficult to explain and likely depend on their local tectonic context.

Although seismic activity is unpredictable, all of Nova Scotia is in a moderately low hazard zone. The southern Bay of Fundy is a moderate hazard zone. The Laurentian Slope is a moderate to high hazard zone (NRCAN 2015). Figure 6.2-5 displays the relative earthquake hazards across Canada as determined by the Geological Survey of Canada (NRCAN 2015).

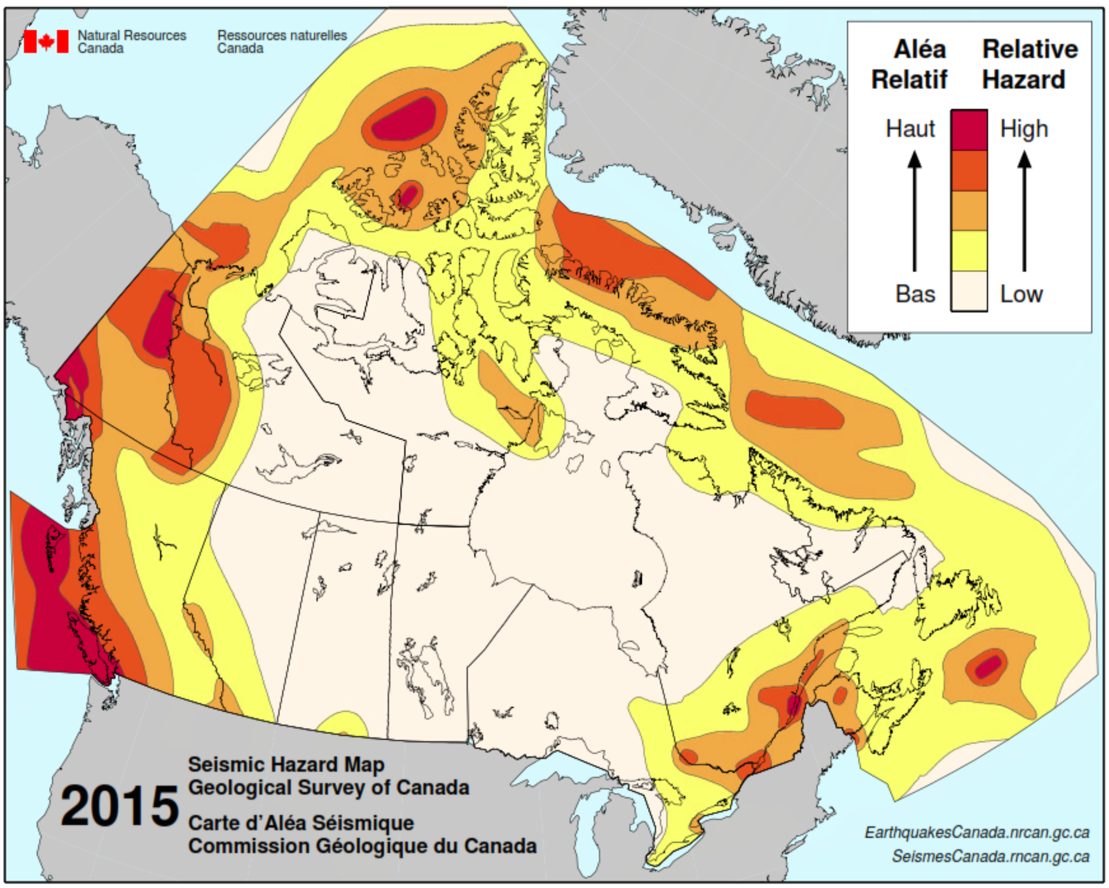

Figure 6.2-5 Relative Earthquake Hazard Map of Canada

Each year, approximately 450 earthquakes occur in eastern Canada, of which four will exceed magnitude 4, 30 will exceed magnitude 3, and 25 events will be reported as felt. A decade will likely include three events greater than magnitude 5. Nova Scotia, in particular, has low seismic activity with records (since 1925) showing a max magnitude of 3.5 (Yarmouth - 2015) and most of the activity occurring in SW Nova Scotia. Figure 6.2-6 displays the distribution and magnitude of earthquakes recorded in eastern Canada over 400 years.

The Northern Appalachians Seismic Zone is located in southwest Nova Scotia. The Beaver Dam Mine Project is located east of this zone. The nearest earthquake to Marinette, Nova Scotia was recorded with a magnitude of 2.7 in 1999 and was located northeast approximately 20 km north of the Project area. Magnitudes of intensity less than 3.0 are not felt by people except under especially favourable conditions, and cause no damage to buildings. The global frequency of earthquakes with magnitude 2.0 to 2.9 is over one million per year.

If an earthquake occurs, seismic activity may affect the Beaver Dam Mine Project through primary impacts such as infrastructure damage facilitated by ground vibrations and secondary impacts such as fires facilitated by damaged infrastructure. Tsunami's, should they be created by offshore earthquakes, are unlikely to impact the Project. The Project is located approximately 30 km from the coast and at an elevation of 140 masl.

Given that Nova Scotia is located in a low hazard zone and the limited extent and duration of the Project, the potential risk of seismic activity affecting the Project is very low and not significant.

6.2.3.6 Isostatic Uplift and Subsidence

During the most recent major advance of the North American ice sheet complex, known as the Wisconsinan Glaciation, the Appalachian Glacier Complex covered the Maritimes. These glaciers formed and grew locally, independent of the Laurentide Ice Sheet due to a combination of increased snowfall, cold temperatures, and isolation from continental glaciers by deep ocean channels and the Appalachian mountain range. The glaciers were centred in the Maritimes, and advanced and retreated at least four times. During each of these cycles, glaciers were centered on land masses and flowed towards the Scotian Shelf and Laurentian Channel or radiated from central Nova Scotia and New Brunswick (NSDNR 2014).

The enormous weight of the Appalachian Glacier Complex caused the surface of the Earth's crust to deform and warp downward, forcing the viscoelastic mantle material beneath to flow away from the central loading region. This caused the central land masses in Nova Scotia and New Brunswick to depress and the outer regions at the limits of the glacier complex to flux upward. Following retreat of the glacier complex, the central land masses in Nova Scotia began to rise to their pre-glaciation position, while the outer regions began to subside. This concept is called isostatic rebound and exacerbates the effects of global sea level rise.

Given the Beaver Dam Mine Project is located approximately 30 km from the coast and average elevation is 140 masl, it is unlikely the effects of isostatic rebound will impact the Project, nor will the Beaver Dam Mine Project impact isostatic rebound.

6.2.3.7 Landslides, Slope Erosion, and Subsidence Following Project Activities

Geotechnical work has been completed at the Touquoy site and the expertise gained from working with these materials will be applied to the final design of the Beaver Dam disturbed areas using actual geotechnical data collected at Beaver Dam to supplement the abundant public information available. Features constructed from site materials such as waste rock stockpiles and overburden stockpiles will use the collected data for final design to produce features with appropriate safety factors to reduce the possibility of landslides, slope erosion and subsidence. With many stockpiles it is common to have subsidence in the short term creating a landscape that is varied in topography.

This is in line with NSDNR objectives for reclamation to have surfaces that are not uniform but offer safe long term landscapes with a variety of features. General reclamation goals to have heterogeneous landscapes that offer habitat features greater than simply a hydro seeded mat are important and can be assisted by some variation in the topography through subsidence.

6.2.4 Consideration of Consultation and Engagement Results

Key issues raised during public consultation and Mi'kmaq engagement relating to geology, soil and sediment include potential ARD, suspended solids and leaching of metals from the rock at the Beaver Dam Mine site which may affect receiving water and its fish habitat, specifically Cameron Flowage, the closest watercourse to the Site.

The results of the public consultation and Mi'kmaq engagement have been considered in the environmental effects assessment, including the Proponent's commitments on mitigation and monitoring measures and proposed compliance and effects monitoring programs, as well as the Proponent's broader commitment to ongoing public consultation and Mi'kmaq engagement. Specific to evaluating the effect on geology, soil and sediment, these are found within the following environmental effects assessment.

6.2.5 Effects Assessment Methodology

6.2.5.1 Boundaries

Spatial Boundaries

The spatial boundary used for the assessment of effects to geology, soil, and sediment is the LAA. As the Project has the potential to cause direct and indirect effects to geology, soil, and sediment within and immediately adjacent to the Project area, the LAA is the most appropriate spatial boundary.

Temporal Boundaries

The temporal boundaries used for the assessment of effects to geology, soil, and sediment are the construction phase, operational phase, and decommissioning and reclamation phase.

Technical Boundaries

No technical boundaries were identified for the effects assessment of geology, soils and sediments.

Administrative Boundaries

ARD is provincially regulated through the Sulphide Bearing Material Disposal Regulations. Contaminated soil and sediment is provincially regulated via the Contaminated Sites Regulations. Sediment quality is compared to the CCME Sediment Quality Guidelines for the Protection of Aquatic Life (Freshwater Interim Sediment Quality Guidelines (ISQG)/ and Probable Effect Level (PEL)).

6.2.5.2 Thresholds for Determination of Significance

There are no regulated or proposed thresholds for geology and soils effects for this site and Project. Sediment has regulated thresholds that are well understood by the proponent and can be quantified through the monitoring program proposed.

6.2.6 Project Activities Interactions and Effects

Table 6.2-4 Potential Soil and Sediment Interactions with Project Activities at Beaver Dam Mine Site

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Clearing, grubbing, and grading in preparation of construction • Rock blasting in preparation of construction • Till and waste rock from site preparation transport and storage • Existing settling pond dewatering in preparation of construction • Watercourse and wetland alteration in preparation of construction • Mine site road construction • Surface infrastructure installation and construction • Collection and settling pond construction • Environmental monitoring • General management of wastes derived from preparation and construction activities • Accidents and malfunctions to include fuel and other spills, forest fires, settling pond overflow, slope failure, an unplanned explosive event, and a mobile equipment accident
Operation and Maintenance	3-4 years	• Rock blasting to access and extract ore • Surface mine dewatering to facilitate access to and extraction of ore • Management of waste rock produced from crushing and preparing ore for transport • Surface Water Management • Petroleum products management • Environmental monitoring of surface water discharges • General management of wastes derived from operation and maintenance activities • Accidents and malfunctions to include fuel and other spills, forest fires, settling pond overflow, slope failure, an unplanned explosive event, and a mobile equipment accident
Decommissioning and Reclamation	1-2 years	• Infrastructure Demolition • Site reclamation activities

Table 6.2-4 Potential Soil and Sediment Interactions with Project Activities at Beaver Dam Mine Site

Project Phase	Duration	Relevant Project Activity
		• Environmental monitoring • General management of wastes derived from decommissioning and reclamation activities • Accidents and malfunctions to include fuel and other spills, forest fires, slope failure, and a mobile equipment accident

Table 6.2-5 Potential Soil and Sediment Interactions with Project Activities along Haul Road

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Clearing, grubbing, and grading in preparation of construction • Rock blasting in preparation of construction • Till and waste rock from site preparation transport and storage • Watercourse and wetland alteration in preparation of construction • Haul road construction and upgrades • Environmental monitoring of surface water • General management of wastes derived from preparation and construction activities • Accidents and malfunctions to include fuel and other spills, forest fires, and a haul truck accident
Operation and Maintenance	3-4 years	• Ore transport • Haul road maintenance and repairs • Environmental monitoring • Accidents and malfunctions to include fuel and other spills, forest fires, and a haul truck accident
Decommissioning and Reclamation		N/A[1]

1 Decommissioning and Reclamation of the haul road is not expected. The haul road will be returned to owner for forestry industry

Table 6.2-6 Potential Soil and Sediment Interactions with Project Activities at Touquoy Processing and Tailings Management Facility

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Accidents and malfunctions to include fuel and other spills, forest fires, and mobile equipment accidents
Operation and Maintenance	3-4 years	• Environmental monitoring of surface water discharges • Accidents and malfunctions to include fuel and other spills, forest fires, and mobile equipment accidents
Decommissioning and Reclamation	1-2 years	• Environmental monitoring • Accidents and malfunctions to include fuel and other spills, forest fires, and mobile equipment accidents

The Touquoy facility is currently under construction. There are no effects to geology, soil, and sediment anticipated to be caused by the processing of ore and the management of tailings from the Beaver Dam Mine Project. The use of the Touquoy facility for the processing of Beaver Dam ore will not involve construction or operation of the mine site or use of the Tailings Management Facility; therefore, no effects are anticipated at the Touquoy facility related to the processing of Beaver Dam ore, with the exception of the continued potential for accidents and malfunctions and continued environmental monitoring. The waste rock stockpile will continue to be monitored throughout the life of the Touquoy facility as per the approved closure and reclamation plan for the Touquoy Gold Mine; this facility will not be used as part of the Beaver Dam Mine Project.

6.2.7 Mitigation and Monitoring

Mitigation and monitoring for the Beaver Dam mine site and the haul road are described below. Mitigation measures and monitoring programs at the Touquoy facility are anticipated to continue as per those put in place throughout the operation of the Touquoy mine (as required by the IA).

Geology, soils and sediment quality baseline is well established and at the Beaver Dam site and Touquoy as outlined in the above sections. Baseline quality has limited issues but there is a need for mitigation measures to limit the mobilization of materials to areas of the site that could results in impacts occurring (wetlands, watercourses and habitats). In general, the mitigation measures relate to limiting sediment and erosion from occurring through management practices outlined in other sections. Geology and soils outside the disturbed area have no potential for impacts and are therefore not part of any mitigation or monitoring program.

Soils are being moved on-site but are being re-used for reclamation purposes to the greatest extent possible, resulting in no net loss. Therefore, there is no need for mitigation or compensation measures, or for monitoring of site soils.

Sediment is a valued part of aquatic habitats and needs to be afforded the protection from new inputs of potential impacts (suspended solids, elevated metals) that can affect invertebrates and other aspects of the aquatic environments dependent on invertebrates such as fish species for example. The measures outlined below will aid in limiting or eliminating impacts but there remains a possibility of impacts and monitoring is prudent. Programs are outlined below as well.

During construction and operations, regular testing of rock will be conducted for acid generating potential at a rate to be determined by NSE, anticipated to be no less than 1 sample per 100,000 tonnes of rock generated.

Table 6.2-7 Mitigation and Monitoring Program for Geology, Soil, and Sediment Quality

Project Activity	Mitigation Measures	Monitoring Program
Site Preparation and Construction	Sediment and erosion control measures.	Annual sampling at select baseline sediment locations (Sed. 1,2,3,6 and 7) for metals suite done for baseline. The MMER will require a more detailed sediment sampling program to determine final EEM program specifications
Operation and Maintenance	Sediment and erosion control measures.	Annual sampling at select baseline sediment locations (Sed. 1,2,3,6 and 7) for metals suite done for baseline During construction and operations, regular testing of rock will be conducted for acid generating potential at a rate to be determined by NSE, anticipated to be no less than 1 sample per 100,000 tonnes of rock generated.
Decommissioning and Reclamation	Sediment and erosion control measures	Annual sampling at select baseline sediment locations (Sed. 1,2,3,6 and 7) for metals suite done for baseline.

6.2.8 Residual Effects and Significance

Residual effects for geology, soils and sediment are not anticipated. The geology of the site and the soils are currently disturbed in many areas of the site. Overburden and soils will be stored temporarily for future reclamation use and some overburden will be reclaimed in its stored location. Sediment has the potential for changes that have possible effects. The mitigation and monitoring programs have been designed to outline and avoid and monitor the potential long term residual impacts.

Table 6.2-8 Residual Environmental Effects for Geology, Soil, and Sediment Quality

Project - VC Interactions	Nature of Effect	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
Downstream sediment quality	A	Select removal of impacted materials in consultation with DFO and other parties if action is deemed net benefit.	M	LAA	MT	S	R	MD	Sediment quality impacted by Project beyond natural fluctuations that affects aquatic habitats and or species negatively.	Not Significant

Legend (refer to Table 5.10-1 for definitions)

Nature of Effect		Geographic Extent		Frequency		Ecological and Social Context	
A	Adverse	PA	Project Area	O	Once	LD	Low Disturbance
P	Positive	LAA	Local Assessment Area	S	Sporadic	MD	Moderate Disturbance
		RAA	Regional Assessment Area	R	Regular	HD	High Disturbance
Magnitude				C	Continuous		
N	Negligible	**Duration**		**Reversibility**			
L	Low	ST	Short-Term	R	Reversible		
M	Moderate	MT	Medium-Term	IR	Irreversible		
H	High	LT	Long-Term				
		P	Permanent				

6.2.9 Proposed Compliance and Effects Monitoring Program

As noted above there is no determined need for geology and soils to have compliance or effects monitoring program. Sediment has a recognized need for an effects monitoring program and the proposed program of monitoring is noted above in Table 6.2-7. The MMER program would involve more detailed sediment and surface water sampling as well as site effluent sampling to determine final EEM program components, locations, frequency and parameters to be sampled for as well as possible species involved in the EEM.

The details of the monitoring programs will be determined in consultation with regulatory agencies and will be described in the application for an IA for the site operations following the EA process. High level detail is needed in this application and would be subject to review by NSE and other agencies. An EMS and EPP will be developed as part of the Project implementation that will confirm the responsibility and system of accountability for the compliance and effects monitoring program.

6.3 Surface Water Quality and Quantity

6.3.1 Rationale for Valued Component Selection

Surface water (quality and quantity) was selected as a Valued Component for its significance to hydrological, ecological and socio-economic systems. Hydrologically and hydrogeologically, surface water consists of stormwater runoff that feeds into various water systems (i.e., rivers, lakes, oceans) including groundwater aquifers through recharge. The potential disconnection between bedrock groundwater aquifers and surface water in the area limits the potential for contaminant transport from surface to groundwater, and it also prevents groundwater recharge after the water table has been drawn down by mine dewatering practices. Aquatic species find habitats in water and terrestrial species rely on an accessible water sources for their survival. Socially and economically, surface water resources are essential to municipal, agricultural, industrial and recreational sectors, among others.

Surface water quality and quantity are provincially regulated through many legislative avenues within the *Environment Act*. The regulations help protect ecological components, as well as the health of the general public. In summary, surface water was selected as a Valued Component for the following reasons:

- Its ecological value in providing habitat for aquatic species;
- The importance of surface water in the daily lives of terrestrial species;
- Its potential to convey storm water;
- The socio-economic importance of surface water from a recreational and resource perspective; and
- Its potential to interact with Project activities

6.3.2 Baseline Program Methodology

6.3.2.1 Project Watersheds Location

An inventory of surface water features was taken of the Beaver Dam Mine Project components to identify those water features that may be impacted directly or indirectly by the proposed mine and haul road construction and operations.

The Project lies within the West River Sheet Harbour drainage basin, which is directly east of the large Musquodoboit River Valley system. The watershed occupies an area of roughly 576 km^2, a moderately sized watershed in the Province. The area is characterized by rolling till plains, drumlin fields, extensive rockland, and numerous freshwater lakes, streams, bogs and wetlands having relatively a low relief, hummocky type terrain. Forests are predominantly coniferous of red and black spruce. According to DNR, the site is in the Eastern Ecoregion of the Acadian Ecozone, the only ecozone in Nova Scotia. The Eastern Ecoregion is underlain by quartzite and slate of the Meguma Group with granitic intrusives. A variety of landforms are found in this ecoregion, including rolling till plains, drumlin fields, extensive rockland, and wetlands. The bedrock is highly visible in those areas where the glacial till is very thin, exposing the ridge topography.

This inland area is somewhat removed from the immediate climatic influence of the Atlantic Ocean and is characterized by warmer summers and cooler winters.

The West River Sheet Harbour drainage basin discharges to the West River and its tributaries, from north to south. Elevations within the catchment vary from approximately 135 to 165 masl in the headwater areas and gradually decrease to sea level at the final outlet located at Sheet Harbour. The headwaters of the drainage basin are located along the topographic divide separating the Musquodoboit River valley to the northwest. The Killag River and Cameron Flowage are the main mapped watercourses of the Site, and Crusher Lake and Mud Lake are the major mapped lakes. The complex system of streams, lakes, bogs and wetlands is a direct result of the underlying bedrock geology of greywacke and slate found in the region. These relatively impermeable and poorly jointed rocks result in slow groundwater recharge and most of the excess surface water is retained on the surface, often called a 'deranged' drainage pattern. The basin ultimately drains to the south via the West River, and discharge peaks are likely attenuated to a large extent by the numerous lakes and wetlands through which runoff is routed. Catchment areas are shown on Figure 6.3-1

The West River Sheet Harbour and Tangier River Secondary boundary runs through the center of the PA along the haul road. Tertiary basins affected by the Project include three within the mine footprint (Cameron Flowage, Tent Lake and Kent Lake) and six along the haul road footprint (Brandon Lake, Rocky Brook Lake, Rocky Lake, Lake Alma, Middle Beaver Lake, and Eagle's Nest Basin Tertiary watersheds).

Available databases were evaluated to identify mapped waterbodies and watercourses with the mine and the haul road footprint PA. A field evaluation followed in the spring and summer of 2015 to confirm the presence of the identified water features within and surrounding the PA. No mapped waterbodies were identified within the haul road footprint. Given the linear nature of the haul road PA, mapped watercourses were grouped into watercourse systems 1-7 based on their tertiary watershed affiliations to aid in field identification. Field evaluation followed in fall 2015 and spring

2016 to confirm the presence of mapped watercourses along the haul road and the identification of additional watercourses within the haul road PA.

Watercourses were documented using an SXBlue II Global Positioning System (GPS) receiver unit capable of sub-meter accuracy with a handheld SXPad field computer. Blue flagging tape was used to mark the locations of all watercourses. Watercourses were mapped to the edge of the PA within the mine and haul road footprint, and provided a specific watercourse identification number. Each watercourse, when identified in the footprint, was described for physical parameters including: bankfull width, wetted width, water depth, structure (pool, riffle, run, flat, others), fish habitat potential, overhanging and in-stream vegetation, substrate, potential to support species at risk (SAR) and species of conservation interest (SOCI) and bank stability. Waterbodies observed in the mine footprint were described for physical characteristics including width and overall size, depth, littoral zone description, potential to support species at risk (SAR) and species of conservation interest (SOCI), shoreline characterization, and substrate.

6.3.2.2 Surface Water Quality

6.3.2.2.1 Beaver Dam Mine Site and Haul Road

Surface water monitoring was conducted at seven locations around the Beaver Dam mine site and 29 locations along the haul road to obtain baseline water quality data. The rationale for each sample location is provided in Table 6.3-1 and Table 6.3-2.

Table 6.3-1 Baseline Surface Water Locations for Beaver Dam Mine Site

Sample ID	Sample Location	Sample Location Rationale
SW-1	Killag River	To characterize surface water quality downstream and east of Project activities
SW-2A	Upstream of Cameron Flowage	To characterize surface water quality upstream and north of Project activities
SW-4A	Wetland downstream of Mud Lake	To characterize surface water quality downstream and north of Project activities
SW-5	Existing settling pond outlet	To characterize surface water quality exiting the existing settling pond into Cameron Flowage and near Project activities
SW-6A	Unnamed stream between Crusher Lake and Mud Lake	To characterize surface water quality downstream and west of Project activities
SW-9	West River Sheet Harbour	To characterize surface water quality in a different watershed for reference
SW-10	Upstream of existing settling pond	To characterize surface water quality entering the existing settling pond

Table 6.3-2 Baseline Surface Water Locations for Haul Road

Sample ID	Sample Location	Sample Location Rationale
WC-2 WC-3 WC-7 to WC-17	Watercourses along Beaver Dam Mines Road portion of the haul road	To characterize surface water quality in watercourses upstream of the Beaver Dam Mines Road portion of the haul road
SW-41 SW-42	Watercourses along new construction through greenfield environment	To characterize surface water quality in watercourses upstream of the new construction portion of the haul road
WC-23 to WC-31	Watercourses along the Moose River Cross Road portion of haul road	To characterize surface water quality in watercourses upstream of the Moose River Cross Road portion of the haul road
SW-43 to SW-47	Watercourses along the Mooseland Road portion of the haul road	To characterize surface water quality in watercourses upstream of the Mooseland Road portion of the haul road

The purpose of this program was to establish a baseline for comparison of surface water quality before and after site activities commence. Each sample was collected as a grab sample and analyzed for general chemistry and metals (RCAp-MS), mercury (Hg), and/or total suspended solids (TSS). TSS analysis was limited to the haul road due to the potential for haul truck traffic to suspend particulate matter for deposition into watercourses adjacent to the haul road. The potential for this interaction at the Beaver Dam mine site is low. Field measurements were recorded for dissolved oxygen (DO), temperature, total dissolved solids (TDS), conductivity, pH, and/or flow rate. Flow rate and water levels at sample locations along the haul road did not allow for consistent field parameter data collection.

Sampling at the Beaver Dam mine site began in October 2014 and was conducted monthly until August 2015. A total of nine sampling events were completed for four of the sampling locations and eight sampling events were completed for two of the sampling locations. A seventh sampling location was added in June, 2015 and was included in three sampling events. Sampling activities were not conducted at any of the sampling locations during the months of February and March 2015 due to winter conditions (i.e. freezing/dry conditions). One sampling event was completed in June 2015 for the 29 sampling locations along the haul road. Analytical results were compared to the CCME FWAL guidelines, updated to 2014 and the MMER guidelines, updated to 2016. Both sets of guidelines represent the maximum authorized concentrations in a grab sample. The surface water sampling locations are provided on Figures 6.3-3 and 6.3-3A to 6.3-3L.

6.3.2.2.2 Touquoy Processing Facility

Surface water quality monitoring was conducted at the Touquoy site prior to construction of the Touquoy Project. Baseline surface water samples were collected and analyzed for RCAp-MS, Hg, and TSS at seven locations throughout the Project area on a monthly basis between September 2004 and January 2007. An eighth station was added in July 2006, and a single sample was collected from an existing exploration decline and Scraggy Lake in January 2007. Historical data from 1988 for Moose River was reviewed as well. Although analytical results were compared to CCME FWAL guidelines from 2006 in the Touquoy EARD, for the purposes of the Beaver Dam EIS, these results have been compared to the CCME FWAL guidelines, updated to 2014 and the MMER guidelines, updated to 2016. No additional surface water data for the Touquoy processing and tailings management facility was collected during the Beaver Dam Mine Project baseline investigations. Surface water quality monitoring at Touquoy is ongoing as part of regulatory requirements. Surface water monitoring locations are shown on Figure 6.1-2 (baseline monitoring locations) and Figure 2.3-1 (compliance monitoring locations required by the IA).

6.3.2.3 Surface Water Quantity

A water balance for the Beaver Dam mine site was calculated to determine the amount of surface water runoff currently created given minimal impermeable surfaces in order to compare it against the amount of water surplus generated from an increase in impermeable surfaces as a result of the Project. The water balance will be used to assist in the evaluation of options to manage surface water surplus.

Climate data for historical average precipitation and evaporation were obtained from Environment and Climate Change Canada's Historical Climate Data website for the Middle Musquodoboit (8203535) and Truro (8205990) weather stations, respectively. The Middle Musquodoboit station is located approximately 25 km from the general Project area, while the Truro station is located approximately 55 km from the general Project area. These climate stations were chosen due to the large amounts of continuously recorded data collected between 1961 and 2010.

The water holding capacity has been estimated using the Stormwater Management Planning and Design Manual from the Ontario Ministry of the Environment (OMOE 2003) which accounts for slope, soil types, and vegetation cover when estimating water holding capacity for an area.

Catchment areas representing primary, secondary and tertiary basins were estimated utilizing GIS.

6.3.3 Baseline Conditions

6.3.3.1 Surface Water Features

6.3.3.1.1 Beaver Dam Mine Site

Within the Beaver Dam mine footprint, four waterbodies: Crusher Lake, Mud Lake, Cameron Flowage, and an unnamed waterbody in the southwest corner of the PA; were identified through a desktop review of available mapping. Five watercourses were similarly identified at the mine site:

- in the south central portion of the mine footprint, and draining north into Crusher Lake. It continues north from Crusher Lake into Mud Lake in the northwest corner of the mine footprint PA;
- in the southwest corner of the mine footprint, draining southwest, outside of the mine footprint and into an unnamed open waterbody along the southwestern edge of the PA;
- in the southeast corner of the PA that drains southeast, outside of the PA boundary;

- in the northwest section of the PA and drains north into Mud Lake; and,
- in the northeast section of the PA draining from a mapped unnamed waterbody inside the PA, into Cameron Flowage in the northeast corner of the PA.

During field evaluations within the mine footprint PA, each watercourse location was evaluated. Some watercourses extended beyond the original mapped footprint while others were removed as they were not found in the field. Some watercourses were shortened or adjusted to reflect headwater wetland habitat and were identified as draining in and out of the corresponding wetland habitat across the PA. A total of 14 watercourses were confirmed within the mine footprint PA. All identified watercourses are described in Table 6.3-3 and shown on Figure 6.3-1. Details of fish habitat potential and fish presence are provided in Section 6.6.

Watercourses within the Site area are first order streams originating within headwater wetland habitat inside of the PA. The most significant stream drains northward from Wetland 48 through Crusher Lake and continues through Wetlands 14 and 17 into Mud Lake. Other streams across the mine footprint are generally small with minimal pool/riffle structure, and consist of mucky organic substrate. Many of these streams would be ephemeral in nature, with little water present at dry times of the year.

There are four waterbodies located within the mine footprint PA. Crusher Lake is located in the western section of the PA, Mud Lake is located in the northwestern corner, and Cameron Flowage is located within the northeast corner, near the location of the proposed open pit. The fourth mapped waterbody (unnamed) is located in the southwest corner of the PA. During the field evaluation, however, this waterbody was confirmed as wetland habitat, and as a result, is described in Section 6.5. The three confirmed waterbodies within the mine footprint PA are described in Table 6.3-4 below.

Table 6.3-3 Mine Site – Physical Characteristics of Watercourses

Watercourse	Tertiary Watershed	UTM East	UTM North	Section Length (m)	Velocity	Gradient	Wetted Width (cm)	Bankfull Width (cm)	Average Depth (cm)	Bank Height (cm)	Substrate (%)	Habitat Type (%)	In-stream Vegetation (%)	Overhanging Vegetation (%)	Coarse Woody Debris
1	Tent Lake	522631	4989087	60	L	M-L	45	60	10	20	SB=80 Gr=20	Run= 100	20	80	M
2	Cameron Flowage	522050	4990014	70	L	M	70	80	15	10	Gr=20 MC=80	Run= 100	40	80	H
3	Cameron Flowage	522024	4989866	50	L	M-L	30	30	5	5	Ru=70 Sa=30	Riffle=80 Pool=20	40	80	L
4	Cameron Flowage	521450	4990084	40	L	L	10	80	5	1	Co=80 Gr=20	Flat=100	40	>95	H
5 (top near WL2)	Cameron Flowage	521808	4989574	100	M	M	60	75	5	15	Si=20 MC=15 SB=20 Ru=30 Pe=15	Run=40 Flat= 60	15	100	M
5 (lower near WL14)	Cameron Flowage	521555	4990209	266	M	M	50-200	100-300	20-60	60	SB=80 Ru=10 Co=10	Run= 70 Riffle=30	20	100	H
6	Cameron Flowage	521379	4990527	30	M	M	20	30	5	10	Ru=60 Co=20 Pe=20	Run=100	10	100	M
7	Cameron Flowage	521438	4990346	100	L	M-L	40	50	3	20	SB=5 Ru=20 Co=20 Pe=20 Gr=10 MC=15	Riffle=15 Pool=15 Glide=70	25	100	M
8	Cameron Flowage	521343	4990272	30	L	L	50	300	10	250	SB=10 Ru=15 MC=35 Si=40	Glide=100	70	75	L
9	Cameron Flowage	521536	4990206	100	H	H	50	200	8	20	SB=50 Ru=30 Co=10 Pe=3 MC=7	Riffle=15 Pool=25 Glide=50 Cascade=10	30	100	M

Table 6.3-3 Mine Site – Physical Characteristics of Watercourses

Watercourse	Tertiary Watershed	UTM East	UTM North	Section Length (m)	Velocity	Gradient	Wetted Width (cm)	Bankfull Width (cm)	Average Depth (cm)	Bank Height (cm)	Substrate (%)	Habitat Type (%)	In-stream Vegetation (%)	Overhanging Vegetation (%)	Coarse Woody Debris
10	Kent Lake	521394	4989508	100	L	L	60	70	10	40	Gr=50 Si-50	Run=100	20	70	M
11	Kent Lake	521166	4989752	250	L	L	150	150	40	150	Ru=5 SB=5 MC=90	Run=100	40	70	H
12	Cameron Flowage	522202	4990328	40	M	L	50-400	100-400	10	10	Gr=40 Si=60	Run=100	15	80	L
13	Cameron Flowage	522689	4990224	60	L	L	300	500	10	20	SB=20 Ru=60 Si=20	Riffle=25 Pool=20 Run=55	80	100	L
14	Cameron Flowage	522734	4990027	150	M	M	100	120	50	10	Co=60 Gr=40	Run=100	0	100	M

Note: Coarse Woody Debris: H:10+ woody debris per 20m reach, M: 10-5 woody debris per 20m reach, L: less than 5 woody debris per 20m section

Velocity: H: flows at a speed at which the water is visually rough and irregular, creates eddies M: flows at a speed which creates smooth riffles L: flows so slowly that the water is smooth and fine sediments are not held in suspension

Substrate: SB: Small Boulder, Ru: Rubble, Co: Cobble, Pe: Pebbles, Gr: Gravel, Sa: Sand, MC: Mud/Clay, Si: Siltation

Gradient: H:>5% slope, M: 2-5% slope L: <2% slope (estimated only)

Habitat Type: **Run**: Swiftly flowing water with some surface agitation but no major flow obstructions, coarser substrate (gravel, cobble, and boulders). **Riffle**: Shallower section with swiftly flowing, turbulent water with some partially exposed substrate (usually cobble or gravel dominated **Flat**: Water surface is smooth and substrate is made up of organic matter, sand, mud, and fine gravel. This habitat differs from a pool due to the length, associated with low gradient. This habitat type generally has a flat bottom. **Pool**: Deeper area comprising full or partial width of stream, due to the depth or width flow velocity is reduced. Pool has rounded surface on bottom. **Cascade**: Areas of steeper gradient with irregular and rapid flows, often with turbulent white water. Rapids are primarily associated with larger stream sections and rivers. In larger rivers it is recommended that the survey crew not attempt to conduct cross sections in these types of habitat. **Glide**: Wide, shallow pool flowing smoothly and gently, with low to moderate velocities and little or no surface turbulence. Substrate usually consists of cobble, gravel and sand.

Table 6.3-4 Waterbodies within the Beaver Dam mine footprint

Watershed	Size (ha)	Depth (m)	Shoreline Characteristics	Littoral Zone Characteristics	Substrate
Crusher Lake	4.5	4 to 10	Organic peatland surrounds approximately 50% of the lake; moderately sloped mineral soil surrounds the remaining margins of the lake. The majority of the lake is unshaded, with only thin bands of shaded areas present along the margins. Mature, discrete, undisturbed forest surrounds the entire lake. Floating peatlands are present along the margins (Wetlands 8 and 10), particularly along the eastern end. A beaver lodge is also present in the eastern end of the waterbody within WL 8.	Organic substrate is present. Floating peatland extends into the waterbody in the eastern and western edges. These lacustrine wetlands support a community of submergent and emergent wetland vegetation. Near discrete upland habitat, the littoral zone is abrupt and generally lacking vegetation. Littoral zone is shaded by adjacent upland forest. Marsh St. John's Wort, Leatherleaf and a variety of sedges are emergent in both of these wetlands.	Muck and organic, with some gravel and cobble
Mud Lake	4.1	2	Entire shoreline is comprised of wetland habitat (WL17). Adjacent to open water, the wetland consists of low ericaceous shrubs and graminoids, with tall shrubs dominant at the wetland/upland edge. Gentle slopes surround the waterbody.	The littoral zone is gently sloped with some evidence of fluctuating water levels. Littoral zone is unshaded by any forest canopy cover, but some shade is provided by emergent and floating wetland vegetation (primarily Leatherleaf and White Water-lily, respectively).	Muck and organic
Cameron Flowage	11	5	Organic peatland surrounds 25% of the waterbody. Sparsely vegetated cobble and rubble shores encompass approximately 35% of the waterbody's shoreline, while mature, undisturbed forest encompasses approximately 40% of the boundary.	Emergent and floating wetland vegetation is present in the littoral zone adjacent to wetland habitat. White Water-lily is the dominant floating species, but emergent Royal Fern and Leatherleaf are also present. Where the shoreline is dominated by cobble and rubble habitat, emergent vegetation is sparse, and habitat diversity is provided primarily by structural features (i.e. cobble, rubble, small boulders). The littoral zone adjacent to upland forest is shaded, generally lacks emergent vegetation, and is comprised of sand, gravel and cobble substrate.	Majority of the substrate is rubble to small boulder, with some areas dominated by gravel and organic material.

6.3.3.1.1 Haul Road

Sixteen (16) mapped watercourses, including two major rivers, West River Sheet Harbour and Morgan River, intersect the haul road footprint. Five smaller waterbodies are mapped west of Lake Alma. During field assessments, however, these five waterbodies were confirmed to be wetland habitat. The wetlands are described in Section 6.5.

Main West River, Sheet Harbour (WRSH)

The West River Sheet Harbour crosses the haul road PA just north of the intersection of the haul road with Highway 224. There is a current bridge crossing at this location that will require upgrading to support road widening and increased truck traffic. The Atlantic Salmon Conservation Centre has completed recent liming programs (2009, 2010) on the West River Sheet Harbour in order to maintain a pH of 5.5 at the river mouth to support quality salmon habitat in the river (Nova Scotia Salmon Federation
http://salmonconservation.ca/en/projects/west_river_sheet_harbour_project_lime_doser_support.

The West River Sheet Harbour commences at headwater lakes including Sand Lake and West Lake just southeast of the community of Pleasant Valley near Upper Musquodoboit. The river drains in the southeast direction, parallel to Highway 224, across the haul road PA and into the Atlantic Ocean at Sheet Harbour, NS. The Killag River commences north of Cameron Flowage (Tait Lake) that is located directly northeast of the mine footprint PA. The Killag River joins the main West River Sheet Harbour southeast of the haul road footprint. Halfyard and Ferguson (June 2009) described the habitat within the West River Sheet Harbour and its main tributary, the Killag River below.

The Main branch of the West River Sheet Harbour (WRSH) originates from Upper Fisher Lake, at the head of the WRSH Secondary Watershed. The WRSH has three primary tributaries (West River Main branch, Killag River, and Little River), and it flows into the Atlantic Ocean in Sheet Harbour. The watershed is largely undeveloped, though extensive timber harvesting is present. Water within the WRSH is naturally high in tannins and flash prone. There are two, large lake-like pools on the system, the uppermost being River Lake at roughly 0.5 km^2 and the lower, Sheet Harbour lake, at roughly 1.2 km^2. A waterfall forms a natural barrier to fish passage approximately 30 km upstream of the head of tide (9.5 km upstream of Beaver Dam Mines Road, where the proposed haul road will cross the WRSH).

The WRSH has experienced acidification, reducing the habitat quality for spawning Atlantic salmon (Southern Upland population). In an effort to improve the quality of fish habitat, the Nova Scotia Salmon Federation installed and operates a continuous lime dosing station in 2005. Its purpose is to increase the pH of the water into a range that is more suitable for juvenile salmon (approximate pH levels of 5.5). This dosing station is located approximately 500 m upstream of the natural barrier to fish passage (10 km upstream of the Beaver Dam Mines Road). According to the Nova Scotia Salmon Federation, the implementation of the lime dosing program has resulted in a significant increase in Atlantic salmon smolt population within the WRSH, and is considered to be one of the most effective salmon habitat restoration programs in the province. Based on its success, the Nova Scotia Salmon Federation is proposing to install a second lime dosing station on the Killag River.

The Killag River

The Killag River is one major tributary to the WRSH. The Killag has a rather long and narrow drainage basin, with a main channel length of approximately 27 km. This system is also organic-acid stained, similar to the WRSH. Land-use within this tertiary watershed is similar to the overall secondary watershed, with sparse development and abundant timber harvesting. The Killag River system has several associated waterbodies, such as Tait Lake and Cameron Flowage. West Lake, Mud Lake and Crusher Lake are associated with sub-tertiary basins that are tributaries to the Killag River. According to local knowledge, the majority of salmon (as well as brook trout, white suckers, American eel and lake chub) spawned in this part of the system. As previously discussed, the Nova Scotia Salmon Federation has proposed the installation of a second lime dosing station along the Killag River to try to replicate successful salmon habitat rehabilitation that was accomplished in the WRSH.

The Morgan River

The Morgan River is one major tributary to the Tangier River that originates at the headwater lakes (including First and Second Essen Lakes) and south of the community of Pleasant Valley, near Upper Musquodoboit. The river drains south/southeast across the haul road PA and into River Lake, east of the haul road, and then joins the main Tangier River to the southeast of the PA. The Tangier River drains from Tangier Grand Lake to the Atlantic Ocean at Tangier, Nova Scotia.

During field assessments in spring and summer 2016, 34 watercourses were mapped and evaluated within the haul road PA. These watercourses straddle seven tertiary watersheds, and many are classified as first order streams, in high positions within the tertiary basins. Others, however, are second and third order streams, positioned lower in the tertiary watersheds and broader secondary watersheds, and offer more substantial aquatic and fish habitat. All watercourses observed within the haul road footprint PA are described in Table 6.3-5 and shown on Figure 6.3-2.

Table 6.3-5 Haul Road – Physical Characteristics of Watercourses

Watercourse	Tertiary Watershed	Crossing Coordinates		Section Length (m)	Velocity	Gradient	Wetted Width (cm)	Bankfull Width (cm)	Average Depth (cm)	Bank Height (cm)	Substrate (%)	Habitat Type (%)	In-stream Vegetation (%)	Overhanging Vegetation (%)	Coarse Woody Debris	Wetland Habitat associated with crossing
		UTM East	**UTM North**													
A	Tent Lake	522628	4988891	26	L	L	20-400	20-400	10-25	1-20	MC=100	Flat= 100	20	65	L	WL120
B	Tent Lake	522705	4988568	40	L	L	20-400	20-400	10-20	1-20	Co=10 MC=90	Glide=80 Riffle=10 Run=10	10	95	M	WL117
C	Tent Lake	522752	4988169	50	L	L	35-80	35-80	5-25	5-40	Ru=10 Co=20 Gr=15 Si=25 MC=30	Flat= 100	10	50	M	WL119, WL118
D	Tent Lake	522828	4987773	25	M	M	25-65	25-80	5-20	5-20	SB=40 Co=50 MC=10	Run=45 Riffle=35 Pocket= 20	0	45	L	WL121
E	Brandon Lake	522907	4987152	75	M	L	25-170	35-180	1-20	10-40	SB=5 Co=50 Pe=30 Gr=15	Run=50 Riffle=5 Glide=30 Pool=15	5	80	H	N/A
F	Brandon Lake	522841	4986566	83	M	L	60-150	70-170	10-30	5-30	Gr=25 MC=75	Run=50 Pool=50	20	70	M	N/A
G	Brandon Lake	522621	4986101	71	L	L	40-350	50-350	5-30	1-10	Co=5 Pe=10 Gr=25 MC=50	Glide=75 Run=25	75	10	M	WL76

Table 6.3-5 Haul Road – Physical Characteristics of Watercourses

Watercourse	Tertiary Watershed	Crossing Coordinates		Section Length (m)	Velocity	Gradient	Wetted Width (cm)	Bankfull Width (cm)	Average Depth (cm)	Bank Height (cm)	Substrate (%)	Habitat Type (%)	In-stream Vegetation (%)	Overhanging Vegetation (%)	Coarse Woody Debris	Wetland Habitat associated with crossing
		UTM East	**UTM North**													
H	Brandon Lake	522562	4985938	100	H	M	100-500	120-500	2-40	10-30	SB=30 Ru=30 Co=30 Pe=10	Run=40 Cascade =25 Riffle=10 Pool=25	0	60	M	N/A
I	Brandon Lake	522547	4985881	64	L	L	30-150	30-150	5-15	1-50	SB=15 Ru=20 Co=60 Gr=5	Pool=20 Riffle=40 Run=40	5	65	L	N/A
J	Brandon Lake	522554	4985838	80	M	M	50-200	60-200	5-23	5-50	Co=15 Pe=15 Gr=15 MC=40	Pool=30 Riffle=30 Run=40	0	70	M	N/A
K	Brandon Lake	522306	4984470	55	M	M	30	40	15	10	SB=40 Gr=20 Sa=40	Riffle=60 Pool=40	5	100	L	N/A
L	Brandon Lake	522312	4984339	47	L-M	M	30	50	10-30	10-20	Pe=50 Gr=50	Run=75 Riffle=20 Pool=5	0	90	I	N/A
M	Brandon Lake	522234	4984150	50	L	L	35-100	50-110	2-45		Gr=10 MC=90	Run=100	5	95	H	N/A
N- West River Sheet Harbour	Brandon Lake /	521887	4983922	113	H	M	1200	1200	100	100-200	LB=5 SB=10 Ru=25 Pe=30	Cascade =10 Glide=25 Riffle=25	10	40	L	N/A

Table 6.3-5 Haul Road – Physical Characteristics of Watercourses

Watercourse	Tertiary Watershed	Crossing Coordinates		Section Length (m)	Velocity	Gradient	Wetted Width (cm)	Bankfull Width (cm)	Average Depth (cm)	Bank Height (cm)	Substrate (%)	Habitat Type (%)	In-stream Vegetation (%)	Overhanging Vegetation (%)	Coarse Woody Debris	Wetland Habitat associated with crossing
		UTM East	**UTM North**													
	Rocky Brook Lake										Gr=30	Run=40				
O	Lake Alma	521193	4983426	30	L	L	40-400	60-430	15	17-23	SB=10 Ru=15 Co=10 MC=65	Riffle=20 Pool=10 Glide=70	7	30	M	WI95 & WL96
P	Lake Alma	520111	4982977	30	M	M	20-120	20-150	10-35	10-40	LB=10 SB=30 Ru=20 Co=20 Pe=10 Gr=10	Riffle=30 Pocket= 20 Run=50	0	0	L	N/A
Q	Lake Alma	518454	4982878	35	L	L	60-160	60-160	10-20	30	SB=30 Co=30 Gr=35 MC=5	Glide=80 Riffle=20	0	10	M	N/A
R	Lake Alma	518335	4982893	100	L	L	80-150	100-180	15	20-45	SB=5 Co=5 MC=90	Glide=10 Pool=85 Riffle=5	30	50	M	
S	Lake Alma	518117	4983044	68	L	L	100-200	100-200	10-20	20-40	Ru=15 Pe=25 Gr=40 MC=20	Glide=50 Run=25 Riffle=25	0	90	I	N/A

Table 6.3-5 Haul Road – Physical Characteristics of Watercourses

Watercourse	Tertiary Watershed	Crossing Coordinates		Section Length (m)	Velocity	Gradient	Wetted Width (cm)	Bankfull Width (cm)	Average Depth (cm)	Bank Height (cm)	Substrate (%)	Habitat Type (%)	In-stream Vegetation (%)	Overhanging Vegetation (%)	Coarse Woody Debris	Wetland Habitat associated with crossing
		UTM East	**UTM North**													
T	Lake Alma	517873	4982824	52	M	L	100-260	100-260	1-19	15-30	MC=20 Gr=10 Pe=20 Co=20 Ru=20 SB=10	Run=85 Riffle=5 Pool=10	N/A	80	m	N/A
U	Lake Alma	517441	4982674	56	L-M	L-M	50-100	50-100	6-40	5-30	MC=50 Co=10 Gr=40	Run=70 Riffle=20 Pool=10	0	90	L	N/A
V	Lake Alma	517395	4982554	65	H	M	80-140	130-150	2-17	5-60	Gr=30 LB=20 Co=30 SB=20	Riffle=5 Run=65 Cascades=30	5	90	L	N/A
W	Lake Alma	517500	4982275	44	M	M	20-150	20-200	5-22	5-20	MC=90 Ru=10	Run=79 Pool=20 Riffle=1	0	90	L	N/A
X	Lake Alma	517549	4982187	70	M	M	25-80	30-100	5-45	5-50	MC=60 Co=20 Pe=20	Riffle=40 Flat= 60	0	40	M	WL114
Y	Lake Alma	517595	4982084	70	M	M	25-80	30-100	5-45	5-50	MC=60 Co=20 Pe=20	Riffle=40 Flat=60	0	40	M	WL115
Z	Lake Alma	517675	4981893	90	L	L	30-200 (downstream), 2500	30-200 (downstream), 2500	12->40	2	Gr=65 Pe=5 MC=30	Run=25 Riffle=5 Pool=70	70	30	L	WL9

Table 6.3-5 Haul Road – Physical Characteristics of Watercourses

Watercourse	Tertiary Watershed	Crossing Coordinates		Section Length (m)	Velocity	Gradient	Wetted Width (cm)	Bankfull Width (cm)	Average Depth (cm)	Bank Height (cm)	Substrate (%)	Habitat Type (%)	In-stream Vegetation (%)	Overhanging Vegetation (%)	Coarse Woody Debris	Wetland Habitat associated with crossing
		UTM East	**UTM North**													
							(upstream)	(upstream)								
AA	Eagles Nest	516527	4979693	105	M	L	50-350	50-350	20	5-15	MC=30 Gr=25 Pe=25 Co=15 Ru=5	Run=100	10	80	20	WL5
AB	Eagles Nest	516303	4979597	40	M	M	20	25	10	5	Sa=100	Run=70 Pocket=30	40	100	L	WL86
AC	Eagles Nest	515091	4979240	60	L	L	50-400	50-600	5-20	5-10	SB=40 Ru=30 Sa=30	Flat=70 Riffle=10 Pool=20	10	50	L	WL76
AD	Eagles Nest	514588	4978868	130	M	L	~1200-1600	1300-1700	100+	25	Too deep to see substrate; Co, Ru, LB, SB	Run=100	1	10	0	N/A
AE	Rocky Lake	514402	4978588	80	M	L	30-120	50-150	10	20	Gr=40 Pe=40 Co=15 Ru=5	Run=80 Riffle=10 Pool=10	10	50	L	WET2
AF	Rocky Lake	514346	4978527	70	L	L	50-180	50-180	20-30	30-35	Ru=25 Co=45 Gr=30	Pool=40 Flat=50 Riffle=10	40	70	M	WL70

Table 6.3-5 Haul Road – Physical Characteristics of Watercourses

Watercourse	Tertiary Watershed	Crossing Coordinates		Section Length (m)	Velocity	Gradient	Wetted Width (cm)	Bankfull Width (cm)	Average Depth (cm)	Bank Height (cm)	Substrate (%)	Habitat Type (%)	In-stream Vegetation (%)	Overhanging Vegetation (%)	Coarse Woody Debris	Wetland Habitat associated with crossing
		UTM East	**UTM North**													
AG	Rock y Lake	514286	4978468	65	M	L	40-90	40-110	20-45	30-50	SB=30 Ru-40 Co=30	Run=50 Cascade =15 Riffle=35	10	55	M	WL68
AH	Rock y Lake	514249	4978518	100	M	L	200-650	200-700	50-80	60-90	SB=10 Ru=30 Co=40 Gr=20	Riffle= 80 Pool=20	30	30	L	N/A

Note: Coarse Woody Debris: H:10+ woody debris per 20m reach, M: 10-5 woody debris per 20m reach, L: less than 5 woody debris per 20m section

Velocity: H: flows at a speed at which the water is visually rough and irregular, creates eddies, heavier riffles to light rapids M: flows at a speed which creates smooth to moderate riffles L: flows so slowly that the water is smooth and fine sediments are not held in suspension

Substrate: LB; Large Boulder, SB: Small Boulder, Ru: Rubble, Co: Cobble, Pe: Pebbles, Gr: Gravel, Sa: Sand, MC: Mud/Clay, Si: Siltation

Gradient: H:>5% slope M: 2-5% slope L: <2% slope (estimated only)

Habitat Type: Run: Swiftly flowing water with some surface agitation but no major flow obstructions, coarser substrate (gravel, cobble, and boulders). Riffle: Shallower section with swiftly flowing, turbulent water with some partially exposed substrate (usually cobble or gravel dominated). Pocket: Turbulence increased greatly by numerous emergent boulders which create eddies or scour holes (pockets) behind the obstructions. Flat: Water surface is smooth and substrate is made up of organic matter, sand, mud, and fine gravel. This habitat differs from a pool due to the length, associated with low gradient. This habitat type generally has a flat bottom. Pool: Deeper area comprising full or partial width of stream, due to the depth or width flow velocity is reduced. Pool has rounded surface on bottom. Cascade: Areas of steeper gradient with irregular and rapid flows, often with turbulent white water. Rapids are primarily associated with larger stream sections and rivers. In larger rivers it is recommended that the survey crew not attempt to conduct cross sections in these types of habitat. Glide: Wide, shallow pool flowing smoothly and gently, with low to moderate velocities and little or no surface turbulence. Substrate usually consists of cobble, gravel and sand.

6.3.3.1.1 Touquoy Processing and Tailings Management Facility

Moose River, the largest watercourse at the Touquoy site, flows along the western border of the property. An unnamed tributary to Moose River flows south through the property, between the open pit and tailings management area. A first order unnamed tributary to the latter, south of the proposed pit, flows southward. Fish River drains Square Lake, northeast of the property, to Scraggy Lake. Fish River then flows west and then south into Lake Charlotte, eventually emptying into Ship Harbour. The Fish River Watershed river system is significant for trout, gaspereau and Atlantic salmon populations (D. Archibald, NSDNR, pers. com.).

As noted in the 2007 Focus Report, hydrogeologic investigations supported by drilling and packer testing indicate that there is no transfer of water between Moose River and subsurface areas of the open pit. The nearest point of Moose River is located approximately 70 metres from the open pit and there are no direct physical connections to the open pit at any point.

Process water at Touquoy will be recycled from the Touquoy pit and from the Touquoy tailings management facility as required. The reclaim water pump and barge, with a re-routed pipeline to the process water tank, will be relocated from the Touquoy tailings management facility to the exhausted Touquoy mine once production of Beaver Dam ore provides sufficient reclaim water accumulation from the tailings slurry.

The approved Touquoy Environmental Assessment stated that the pit would be allowed to fill naturally with water over a period of time through precipitation, surface flow and groundwater in-flow. No change to this method is planned following the deposition of Beaver Dam tails, except that the time frame for refilling will be shorter given the decrease in available volume taken by the tailings.

6.3.3.2 Surface Water Quality

Water quality in the PA is characterized as relatively pristine, with very little influence from past mining activities, local industry, road salting, or local residents. Some localized influences from road work (culverts, ditching) or forestry use would have occurred historically (suspended solids for example) but these would be localized and short term variations. Portions of the haul road where NSTIR had a role in winter maintenance may have had use of salt and/or sanding but there is little documented on this available publically.

The majority of nutrients were below or slightly above detectable concentrations, indicating little to no influence from agricultural operations in the area. Dissolved ions were low and the water was very soft, indicating little mineral content and influence from weathered rock. The watersheds have been logged extensively, yet turbidity is low, indicating a lack of silt in the soils and/or little erosion from logging practices. The haul roads have been used to haul timber as well; however TSS levels were low, which may be attributable to existing road conditions and allowable speeds.

The majority of metal concentrations were below detectable levels. At the Beaver Dam Mine site, aluminum and iron exceeded the CCME FWAL guidelines at all sampling locations during most sampling events; however, this is a common feature of surface water in Nova Scotia. Mercury was identified above the CCME FWAL guidelines at all sampling locations during the last sampling event in August 2015, and arsenic concentrations were identified above the CCME FWAL guidelines at SW-4A, SW-5, SW-6A, and SW-10. Arsenic concentrations were variable at all sampling locations, but were generally elevated in the summer months. Arsenopyrite, an iron arsenic sulfide compound, is common in the surficial and bedrock geology of the area. Lead, cadmium, and copper fluctuates in surface water at most sampling locations and at times slightly exceeded the CCME FWAL guidelines at SW-4A (cadmium), SW-6A (cadmium and copper), and SW-10 (cadmium, copper, and lead).

Along the Haul Road, aluminum exceeded the CCME FWAL guidelines at all sampling locations and iron exceeded the guidelines at all but three sampling locations. Arsenic, copper, and lead concentrations were identified to exceed the CCME FWAL guidelines at several sampling locations (SW-43, SW-45, and/or SW-47).

At the Touquoy site, Aluminum and iron exceeded the CCME FWAL at all sampling locations with the exception of the sample collected from Scraggy Lake; however, this is a common feature of surface water in Nova Scotia. Arsenic concentrations fluctuated at all sampling stations, in particular in Moose River where in the summer (lower water flow) this metal was elevated above the CCME FWAL guidelines. Arsenopyrite, an iron arsenic sulfide compound, is common in the surficial and bedrock geology of the area. Lead, cadmium, copper, selenium, and zinc fluctuated throughout the year at most sampling locations and sometimes slightly exceed the CCME FWAL guideline. Mercury was detected at one location (SW8) at concentrations near the detection limit.

Alkalinity was low at all sampling locations throughout the PA. This is anticipated due to the surficial geology being resistant to weathering and containing little carbonate. Lime applied to lawns and gardens increases alkalinity, but this practice is not evident by the water quality data. pH was generally low in all sampling locations and outside the range identified in the CCME and MMER guidelines; however, this a common feature of surface water in Nova Scotia being influenced by acidic precipitation originating in the northeast United States. At the Touquoy site, pH measures were highly variable, in particular on Moose River, where on several sampling events at two sampling stations, the pH varies by two orders of magnitude. DO concentrations measured in the field were identified above the CCME FWAL guidelines at the majority of sampling locations. A summary of parameters exceeding the CCME FWAL and MMER Guidelines is provided in Table 6.3-6 to Table 6.3-8.

Table 6.3-6 Summary of Surface Water Quality for Beaver Dam Mine Site

Sample ID	Sample Location	Parameters Exceeding CCME FWAL	Parameters Exceeding MMER
SW-1	Killag River	pH, DO, Aluminum, Iron, Mercury	pH
SW-2A	Upstream of Cameron Flowage	pH, DO, Aluminum, Iron, Mercury	pH
SW-4A	Wetland downstream of Mud Lake	pH, DO, Aluminum, Arsenic, Cadmium, Iron, Mercury	pH
SW-5	Existing settling pond outlet	pH, DO, Aluminum, Arsenic, Iron, Mercury	pH

Sample ID	Sample Location	Parameters Exceeding CCME FWAL	Parameters Exceeding MMER
SW-6A	Unnamed stream between Crusher Lake and Mud Lake	pH, DO, Aluminum, Arsenic, Cadmium, Copper, Iron, Mercury	pH
SW-9	West River Sheet Harbour	pH, DO, Aluminum, Iron, Mercury	pH
SW-10	Upstream of existing settling pond	pH, DO, Aluminum, Arsenic, Cadmium, Copper, Iron, Lead, Mercury	pH

Table 6.3-7 Summary of Surface Water Quality for Haul Road

Sample ID	Sample Location	Parameters Exceeding CCME FWAL	Parameters Exceeding MMER
WC-2, WC-3, WC-7 to WC-17	Watercourses along Beaver Dam Mines Road portion of the haul road	Aluminum, iron, pH	pH
SW-41	Watercourse along new construction through greenfield environment	Aluminum, pH	pH
SW-42	Watercourse along new construction through greenfield environment	Aluminum, iron, pH	pH
W-23 to WC-28	Watercourses along the Moose River Cross Road portion of haul road	Aluminum, iron, pH	pH
WC-29	Watercourse along the Moose River Cross Road portion of haul road	Aluminum, pH	pH
WC-30, WC-31	Watercourses along the Moose River Cross Road portion of haul road	Aluminum, iron, pH	pH
SW-43	Watercourse along the Mooseland Road portion of the haul road	Aluminum, copper, iron, lead, pH	pH
SW-44	Watercourse along the Mooseland Road portion of the haul road	Aluminum, iron, pH	pH
SW-45	Watercourse along the Mooseland Road portion of the haul road	Aluminum, arsenic, iron, pH	pH

Sample ID	Sample Location	Parameters Exceeding CCME FWAL	Parameters Exceeding MMER
SW-46	Watercourse along the Mooseland Road portion of the haul road	Aluminum, iron, pH	pH
SW-47	Watercourse along the Mooseland Road portion of the haul road	Aluminum, iron, lead, pH	pH

Full analytical results compared to the CCME FWAL and MMER guidelines are included in **Appendix D**.

Table 6.3-8 Summary of Surface Water Quality for Touquoy Mine Site

Sample ID	Sample Location	Parameters Exceeding CCME FWAL	Parameters Exceeding MMER
SW1	Moose River, upstream of Touquoy operations	pH, Aluminum, Arsenic, Cadmium, Copper, Iron, Zinc	pH
SW2	Moose River, downstream of Touquoy operations	pH, Aluminum, Arsenic, Iron, Lead	pH
SW3	Unnamed tributary of Moose River, downstream of Touquoy operations	pH, Aluminum, Iron, Zinc	pH
SW4	Fish River, downstream of Touquoy operations	pH, Aluminum, Cadmium, Copper, Iron, Lead, Selenium, Zinc	pH
SW5	Unnamed tributary of Moose River, downstream of Touquoy operations	pH, Aluminum, Arsenic, Copper, Iron, Lead, Selenium, Zinc	pH
SW6	Unnamed tributary of Moose River, downstream of Touquoy operations	pH, Aluminum, Arsenic, Cadmium, Copper, Iron, Lead, Selenium	pH
SW7	Unnamed tributary of Moose River, on the mine site at Mooseland Road	pH, Aluminum, Iron	pH
SW8	Unnamed tributary of Moose River, downstream of Touquoy operations	pH, Aluminum, Arsenic, Cadmium, Iron, Lead	pH

Sample ID	Sample Location	Parameters Exceeding CCME FWAL	Parameters Exceeding MMER
SW9	Existing mine pit extent	pH, Aluminum, Arsenic, Iron	
SW10	Scraggy Lake, downstream of Touquoy operations	pH, Aluminum	pH

Full analytical results compared to the CCME FWAL (2006) guidelines are included in Appendix F of the EARD submitted to NSE in March 2007. The surface water sampling locations are provided on Figures 6.3-3, 6.3-3A to 6.3-3L, and 6.1-2.

6.3.3.3 Surface Water Quantity

6.3.3.3.1 Beaver Dam Mine Site

The primary surface water drainage system through the Beaver Dam mine site flows northward from Crusher Lake to Mud Lake and then northeastward into Cameron Flowage that forms part of the Killag River. West Lake and Tait Lake, located northwest of the site, discharge into a series of tributaries that flow southward into Cameron Flowage. Several small, ephemeral tributaries of this water system are also present.

In addition to the major water system, a 16 ha headwater bog is located south of the mine site. The bog discharges south into streams, another wetland system, and into Tent Lake. There is also a surface water system that originates at an unnamed lake located south of the site that continues to flow south through Paul Brook and discharge into the West River Sheet Harbour.

A man-made pond was created when the previously blasted exploration decline was allowed to fill in. Approximately 80% of this pond is located in the proposed pit of the site. The pond discharges to Cameron Flowage through an open channel. There is potential for all surface water systems to be impacted by the proposed works either directly or indirectly through facilitated pathways.

A water balance was undertaken to determine the amount of water surplus generated on the Site in its existing, pre-development, conditions. The results can assist in the evaluation of water management options for Site design by comparing pre to post-development water surplus values. Catchment area, precipitation and evaporation data and storage capacity for the Project area were acquired to complete the water balance calculations.

Catchment Delineations

The Site was divided into three sub-catchment areas and one overall catchment area for the purpose of calculating the water balance. The three separate catchment areas represent two catchments that contribute flow from the PA to Mud Lake (approximately 165 ha and titled Catchment 1 and 2) and a catchment area that drain into an unnamed lake feature that discharges into Cameron Flowage (approximately 46 ha and titled Catchment 3). The overall catchment area represents the entire contributing drainage area to Cameron Flowage at the downstream side of the Beaver Dam mine site PA (approximately 3,790 ha and titled Catchment 4). The mine site represents approximately 5% of the contributing drainage area to Cameron Flowage downstream of the PA.

The contributing drainage area to Mud Lake (approximately 165 ha) was divided into two separate drainage areas. The larger of the two encompasses the flow to Mud Lake originating from Crusher Lake and its contributing drainage area (approximately 140 ha). The second drainage area (approximately 25 ha) encompasses the area adjacent to Cameron Flowage that flows north into the southeast corner of Mud Lake.

The contributing watersheds were delineated using ArcHydro. ArcHydro is a geospatial and temporal data model for water resources, designed to operate within ArcGIS. The ArcHydro model is used to extract topological variables from a digital elevation model (DEM) such as flow direction, flow accumulation, stream definition, stream segmentation and as final result watershed delineation. The DEM for the Site was generated based on LiDAR data that was flown by Leading Edge Geomatics.

Climate Data

Climate data including historical average monthly precipitation records were obtained for the Environment and Climate Change Canada Middle Musquodoboit weather station. The station is located approximately 25 km from the Site. The station was selected for its large, continuous record that was collected between 1961 and 2010. Average climate conditions for the Project area were calculated using 30 year averages (climate normal) obtained from data collected for the period of 1981 to 2010. A summary of the climate normals data used in the water balance calculations for the Site are provided in Table 6.3-9.

Table 6.3-9 Summary of Climate Norms for Station 8203535, Middle Musquodoboit, Nova Scotia (1981-2010)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
Mean Temp (°C)	-6.2	-5.2	-1.3	4.4	9.9	14.8	18.5	18.4	14.2	8.5	3.5	-2.4	6.4
Mean Max Temp (°C)	-0.9	0.2	3.9	9.6	16.1	21.3	24.7	24.6	20.3	14	7.8	2.2	12.0
Mean Min Temp (°C)	-11.4	-10.6	-6.4	-0.9	3.7	8.3	12.2	12.2	7.9	2.9	-1	-7.1	0.8
Extreme Max Temp (°C)	16.5	17	26	28	33.3	33.9	34.5	35.6	33	26.7	23.5	15.6	-
Extreme Min Temp (°C)	-34	-33	-31	-15	-7.8	-3	1.1	-1.5	-4.5	-10.6	-21	-34	-

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Average Total Rain (mm)	80.4	62.1	92.8	99.5	104.9	99.8	103.8	91.9	110.7	116.7	128.6	97.2	1188.3
Average Total Snow (cm)	49.4	41.3	31.4	9.5	0.5	0	0	0	0	0	8.2	31.9	172.2
Average Total Precipitation (mm)	129.8	100.5	124.2	109	105.4	99.8	103.8	91.9	110.7	116.7	136.8	129.1	1357.6

Being somewhat inland, the Musquodoboit Valley's climate is still highly influenced by the Atlantic Ocean. Although winters are generally mild and summers are generally cool, the inland position of the region still creates some extreme temperature ranges within seasons. As shown in Table 6.3-9, the Middle Musquodoboit climate station recoded an average annual total precipitation of approximately 1350 mm over a 30 year period from 1981 to 2010; approximately 1,188 mm fell as rain, while 172 cm fell as snow.

Table 6.3-10 presents Depth Duration Frequency (DDF) rainfall data that is used to represent the design rainfall events at the Site, which is taken from the Truro station (Climate ID 8205990) from Environment and Climate Change Canada Short Duration Rainfall Intensity-Duration–Frequency Data. This station was selected based on its relative close approximation to the Site (approximately 38 km) and the long data record used for the estimation of the DDF data (21 years). The data in Table 6.3.10 represents the probability that a given average rainfall depth will occur within a given time period. This data is typically used for engineering design purposes.

Climate data for the Beaver Dam mine site also applies to the haul road and the Touquoy Processing and Tailings Management Facility.

Table 6.3-10 Depth Duration Frequency (DDF) Rainfall

Duration	Rainfall Depth (mm) and Frequency					
	1:2 Years	1:5 Years	1:10 Years	1:25 Years	1:50 Years	1:100 Years
5 minutes	5.2	6.8	7.8	9.2	10.2	11.2
10 minutes	8.2	10.7	12.3	14.4	16	17.5
15 minutes	10.1	13	14.9	17.4	19.2	21
30 minutes	13.8	18.5	21.7	25.6	28.5	31.5
1 hour	18.6	24.3	28	32.7	36.2	39.7
2 hours	25.2	33.2	38.6	45.3	50.3	55.2
6 hours	41.2	51.4	58.2	66.7	73	79.3
12 hours	48.8	60.2	67.8	77.3	84.4	91.4
24 hours	58.5	73.8	83.9	96.7	106.1	115.5

Evapotranspiration Potential

Evaporation describes the process of the return of moisture to the atmosphere from open water and land surfaces. Evaporation from plant surfaces is called evapotranspiration. The magnitude of evaporation or evapotranspiration over time is a function of the climate, soil, and the vegetation in the area. Evaporation rates tend to peak in the summer months when temperatures are highest, daylight hours are longest, sun intensity is greatest, and the growing season is at its peak.

Lake evaporation is the amount of evaporation from an open water body. In Atlantic Canada, lake evaporation rate is greater than the standard evaporation rate because of the constant availability of water. For this analysis, lake evaporation rates were collected from a weather station in Truro, Nova Scotia for the period of 1961 to 2010. The average total annual lake evaporation rate is 481 mm per year. July represents the month with the highest lake evaporation rate on average, at 110 mm per month. The temperature during the winter months of December, January, February and March are typically below zero degrees during which time there may be little to no evaporation. Table 6.3-11 provides a summary of the lake evaporation rates used as a water loss parameter in the water balance assessment.

Table 6.3-11 Average Lake Evaporation per Year

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Lake Evaporation (mm)	0	0	0	30	90	100	110	95	6	35	15	0	481

Infiltration Factor

Currently, the area consists of bare earth land with minimal impervious surfaces. According to the Soil Survey Report from Agricultural and Agri-Food Canada, the soils underlying the Site are described as sandy loam and sandy clay loam with moderate runoff potential, and moderate infiltration soil groups B and C. The infiltration factor of the soil was determined from Table 3.1 provided in the Ontario's Stormwater Management Planning and Design Manual. The infiltration factor was calculated as the sum of the topographic, soils and cover factors that were selected as 0.25 (flat, rolling hills), 0.2 (woodland) and 0.25 (peat, Halifax) respectively, for the Catchment 1. For Catchment 2 the infiltration factor was calculated as the sum of 0.15 (rolling, hilly hills), 0.2 (woodlands), 0.25 (peat, Halifax). For Catchment 3 the infiltration factor was calculated as the sum of 0.15 (hilly land), 0.2 (woodland) and 0.3 (shaly loam). Finally, the infiltration factor for Catchment 4 was calculated as the sum of 0.25 (flat, rolling hills), 0.2 (woodland) and 0.2 (medium combinations of clay and loam).

Mean Annual Runoff

Table 6.3-12 Average Lake Evaporation per Year

Catchment	Flows To	Definition of Qualitative Categories	
		Area (ha)	Mean Annual Runoff (m3)
1	Mud Lake	140	373,380
2	Mud Lake	25	90,429

Catchment	Flows To	Definition of Qualitative Categories	
		Area (ha)	Mean Annual Runoff (m3)
3	Cameron Flowage	46	162,474
4	Cameron Flowage	3,790	13,477,240

6.3.3.3.2 Haul Road

An initial assessment of the existing haul road identified 23 watercourse crossings: 20 culverts (smaller watercourses) and 3 timber bridges (watercourses 6 to 13 m in width). The bridges were considered to be in good condition. A large number of the culverts were poorly installed (i.e., buried, caved in, plugged, hung, not present, water flowing through the road base and not the culvert). The overall poor culvert conditions has contributed to localized poor surface water quality conditions and obstructed fish passage.

There is a potential for all surface water systems along the haul road to be impacted by the proposed works. There is also an opportunity for improvement of the existing surface water conditions.

6.3.3.3.3 Touquoy Processing and Tailings Management Facility

Two main surface water systems flow through the area of the Touquoy facility. One system flows from Square Lake through Fish River and the other flows from Long Lake and the New Dam Flowage through Moose River. Both surface water systems in the area discharge to Scraggy Lake, located south of the facility.

The surface water systems in the vicinity of the processing and tailings management facility have the potential to be disturbed by the Project works; however, there are no predicted changes to the hydrogeology or hydrology of the open pit mine due to the storage of Beaver Dam tailings. The open pit is physically disconnected from the nearby Moose River. As originally planned in the approved Touquoy Gold Mine Project Reclamation Plan, the inflow of groundwater, surface flow, and precipitation into the pit will naturally create a lake upon closure of the site.

6.3.4 Consideration of Consultation and Engagement Results

Key issues raised during public consultation and Mi'kmaq engagement relating to surface water quality and quantity include potential effect from ARD, suspended solids and leached metals from the Beaver Dam Mine site activities. Potential effects on the quantity of surface water near the Beaver Dam pit were noted, specifically effects on water levels in Cameron Flowage. Concerns were identified related to effects on surface waters along the haul route, specifically during construction activities. At the Touquoy site, questions arose about potential effects on Moose River from placement of tailings in mined out pit. Questions were identified on potential effects on receiving waters in the event of unplanned releases due to accidents and malfunctions, specifically during operation. Potential effects on traditional uses of land and resources by the Mi'kmaq were noted, including importance of clean water to support the natural environment, including fish, flora, fauna and drinking water.

The results of the public consultation and Mi'kmaq engagement have been considered in the environmental effects assessment, including the Proponent's commitments on mitigation and monitoring measures and proposed compliance and effects monitoring programs, as well as the Proponent's broader commitment to ongoing public consultation and Mi'kmaq engagement. Specific to evaluating the effect on surface water quality and quantity, these are found within the following environmental effects assessment.

6.3.5 Effects Assessment Methodology

6.3.5.1 Boundaries

Spatial Boundaries

The spatial boundary used for the assessment of effects to surface water quality and quantity is the RAA. As the Project has the potential to cause direct and indirect effects to surface water quality and quantity, as well as cause cumulative effects compounded spatially and temporally from other Projects, the RAA is the most appropriate spatial boundary.

The RAA in the context of surface water quality and quantity is limited to the catchment areas identified in Table 6.3-12, and corresponding Figures 6.3-1 and 6.3-2.

The Local Assessment Area (LAA) is assigned as the spatial boundary for the surface water quality and quantity Valued Component (VC) (as per Table 5.4-1). Project activities may potentially affect water courses and water bodies within and immediately adjacent to the Beaver Dam Mine Site Project Area (PA).

It is important to note that the size of the LAA depends on the VC being considered and therefore, LAA for one component may not be the same as for another. The LAA for the surface water component should consider all surface water features located within the catchment areas that intersect the PA, as well as any downstream areas that may be impacted by a change in flow rate (or surface water quantity). A decrease or increase in surface water quantity (causing flooding) may impact downstream hydrological, ecological and socio-economic systems.

Temporal Boundaries

The temporal boundaries used for the assessment of effects to surface water quality and quantity are the construction phase, operational phase, and decommissioning and reclamation phase.

Technical Boundaries

No technical boundaries were identified for the effects assessment of surface water quality and quantity.

Administrative Boundaries

As the Project is a metal mine, surface water discharges from the Beaver Dam mine site to Cameron Flowage will adhere to the requirements of the MMER, while surface water quality along the haul road will be compared to criteria from the CCME FWAL guidelines. Guidelines from the Nova Scotia Contaminated Sites Regulations will be utilized should accidents and malfunctions related to Project activities lead to a release to surface water.

There may be other requirements for monitoring of surface water discharges through provincial approvals to be obtained prior to the start of the Project.

Administrative boundaries that must be considered with respect to surface water quantity component of the Project include: (i) the Fisheries Act (DFO); and (ii) Activities Designation Regulations of the Environment Act (NSE). Any physical activities in wetlands, watercourses or waterbodies may require authorization in accordance with the Fisheries Act. The Activities Designation Regulations section of the Environment Act requires water approvals and/or notification of water withdrawal, alteration of waterbodies, watercourses and/or wetlands.

Other guidelines regarding surface water quantity that should be considered for Site design, construction, operation and reclamation phases are:

- Erosion Sediment Control Handbook for Construction Sites (NSE, 1988)
- Guide to Altering Watercourses (NSE, 2015a)
- Nova Scotia Watercourse Alterations (NSE, 2015b)
- Storm Drainage Works Approval Policy (NSE, 2002a)

6.3.5.2 Thresholds for Determination of Significance

Surface Water Quality

General mining operations including the storage and handling of diesel, the use of ANFO for blasting, and the disturbance of soil and bedrock from site preparation, general construction, and operation of the surface mine has the potential to adversely affect surface water discharged from the Beaver Dam mine site.

A significant adverse effect to surface water quality at the Beaver Dam mine site is defined as a repeated or sustained surface water discharge from the mine site to Cameron Flowage that exceeds the authorized limits of deleterious substances listed in Schedule 4 of the MMER. Table 6.3-13 lists these limits.

Table 6.3-13 Schedule 4 Limits of the Metal Mining Effluent Regulations

Deleterious Substance	Maximum Authorized Monthly Mean Concentration	Maximum Authorized Concentration in a Composite Sample	Maximum Authorized Concentration in a Grab Sample
Arsenic	0.50 mg/L	0.75 mg/L	1.00 mg/L
Copper	0.30 mg/L	0.45 mg/L	0.60 mg/L
Cyanide	1.00 mg/L	1.50 mg/L	2.00 mg/L
Lead	0.20 mg/L	0.30 mg/L	0.40 mg/L
Nickel	0.50 mg/L	0.75 mg/L	1.00 mg/L
Zinc	0.50 mg/L	0.75 mg/L	1.00 mg/L
Total Suspended Solids	15.00 mg/L	22.50 mg/L	30.00 mg/L
Radium 226	0.37 Bq/L	0.74 Bq/L	1.11 Bq/L

In addition, disturbance of soil and bedrock through site preparation and construction, general maintenance including regrading and de-icing, and dust suspension from operation of the haul road has the potential to adversely affect surface water quality in streams and rivers crossing the haul road through culverts and under bridges.

A significant adverse effect to surface water quality along the haul road is defined as a repeated or sustained exceedance of the CCME FWAL criteria for Total Suspended Solids (TSS) in surface water samples collected in situ. The CCME FWAL criteria are as follows:

- Clear Flow: maximum increase of 25 mg/L from background levels for any short-term exposure (e.g. 24-hour period). Maximum average increase of 5 mg/L from background levels for longer term exposure (e.g. inputs lasting between 24 hours and 30 days);
- High Flow: maximum increase of 25 mg/L from background levels at any time when background levels are between 25 and 250 mg/L should not increase more than 10% of background levels when background is ≥ 250 mg/L.

Should a release resulting in contamination to surface water occur, the Nova Scotia Contaminated Sites Regulations – Tier 1 Environmental Quality Standards for the Protection of Freshwater Aquatic Life in Surface Water (NSE 2014), Section 1, Table 3 is applicable. Exceedances of these criteria from a release would result in a significant adverse effect.

Surface Water Quantity

During Site development much of the natural landscape will be converted to impervious surfaces, increasing the rate of runoff generated on Site. In order to protect downstream lands from potential erosion and flooding, the Site surface water drainage system should be designed to maintain pre-development runoff rates. It is also important to ensure post-development runoff rates are not less than pre-development values to mitigate adverse impacts on aquatic ecosystems or water resources, downstream. As such, the pre-development runoff rates are the threshold for the determination of significance to surface water quantity.

Pre-development runoff rates were determined for each of the four catchment areas identified within the PA using the water balance calculations. Their values are presented in Table 6.3-12.

6.3.6 Project Activities and Surface Water Interactions and Effects

Potential interaction between Project activities and surface water quality and quantity within the PA is outlined in Tables 6.3-14 to 6.3-16 below.

Table 6.3-14 Potential Surface Water Interactions with Project Activities at Beaver Dam Mine Site

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Clearing, grubbing, and grading in preparation of construction • Rock blasting in preparation of construction • Till and waste rock from site preparation transport and storage

Table 6.3-14 Potential Surface Water Interactions with Project Activities at Beaver Dam Mine Site

Project Phase	Duration	Relevant Project Activity
		• Existing settling pond dewatering in preparation of construction • Watercourse and wetland alteration in preparation of construction • Mine site road construction • Surface infrastructure installation and construction • Collection and settling pond construction • Environmental monitoring of surface water discharges • General management of wastes derived from preparation and construction activities • Accidents and malfunctions to include fuel and other spills, forest fires, settling pond overflow, slope failure, an unplanned explosive event, and mobile equipment accidents
Operation and Maintenance	3-4 years	• Rock blasting to access and extract ore • Surface mine dewatering to facilitate access to and extraction of ore • Management of waste rock produced from crushing and preparing ore for transport • Treatment of site surface water runoff and surface mine pumped water • Petroleum products management • Site maintenance and repairs • Environmental monitoring of surface water discharges • General management of wastes derived from operation and maintenance activities • Accidents and malfunctions to include fuel and other spills, forest fires, settling pond overflow, slope failure, an unplanned explosive event, and mobile equipment accidents
Decommissioning and Reclamation	1-2 years	• Infrastructure demolition • Site reclamation activities • Environmental monitoring of surface water discharges • General management of wastes derived from decommissioning and reclamation activities • Accidents and malfunctions to include fuel and other spills, forest fires, slope failure, and mobile equipment accidents

Table 6.3-15 Potential Surface Water Interactions with Project Activities along Haul Road

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Clearing, grubbing, and grading in preparation of construction • Rock blasting in preparation of construction • Till and waste rock from site preparation transport and storage • Watercourse and wetland alteration in preparation of construction • Haul road construction and upgrades • Environmental monitoring of surface water • General management of wastes derived from preparation and construction activities • Accidents and malfunctions to include fuel and other spills, forest fires, and a haul truck accident
Operation and Maintenance	3-4 years	• Ore transport • Haul road maintenance and repairs • Environmental monitoring of surface water • Accidents and malfunctions to include fuel and other spills, forest fires, and a haul truck accident
Decommissioning and Reclamation		N/A[1]

1 Decommissioning and Reclamation of the haul road is not expected. The haul road will be returned to owner for forestry industry

Table 6.3-16 Potential Surface Water Interactions with Project Activities at Touquoy Processing and Tailings Management Facility

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Tailings line alteration • Accidents and malfunctions to include fuel and other spills, forest fires, and mobile equipment accidents
Operation and Maintenance	3-4 years	• Ore management and processing • Management of tailings produced from processing ore • Environmental monitoring of surface water discharges • General management of waste derived from processing activities • Accidents and malfunctions to include fuel and other spills, forest fires, and a haul truck accident
Decommissioning and Reclamation	1-2 years	• Environmental monitoring of surface water discharges • Accidents and malfunctions to include fuel and other spills, and forest fires

Impacts to surface water quality and quantity are not anticipated to affect Beaver Lake IR 17, which is a satellite community of the Millbrook First Nation located approximately 5 km south of the Beaver Dam mine site.

6.3.6.1 Beaver Dam Mine Site

The mine site includes the source and headwaters of Mud Lake as well as a small portion of the Cameron Flowage contributing drainage area. Development of the mine will result in an artificial and managed regime of surface water movement and runoff at the site. Runoff from the mine will be managed to ensure that it meets acceptable environmental standards. The exposed surfaces in the surface mine and on access roads will lead to increased, flashier, runoff patterns during rainfall events.

Surface water runoff from the surrounding area of the mine site, stockpiles, mine site roads and till stockpiles will be managed with the aid of berms and newly constructed channels, which will discharge into a collection/sedimentation ponds. Surface runoff that falls directly into the mine will be dewatered and also discharged into the settling pond. Discharge from the settling ponds will be controlled to meet acceptable environmental standards and maintain existing pre-development water balance conditions. The overall change in surface water quantity will be small due to the small size of the quarry relative to the overall watershed area and the runoff control measures proposed at the site.

Publicly available surface water quality data and results from field collected samples were used to provide current baseline data. The data was used in the design of the Project infrastructure and will provide a snapshot of conditions for 2016/17.

6.3.6.2 Haul Road

Portions of the haul road will have to be widened to accommodate two-way traffic. However, some deviations in the existing route will be required and new road construction will be completed. This will marginally increase the quantity of surface water runoff within the haul road PA. Road construction will include a clear porous subgrade or cross drainage culverts in order for wetland hydrology to be maintained post-construction.

The haul road crosses three watercourses, which are between 6 and 13 m wide, via single lane timber bridges. These bridges will be replaced with dual lane, clear-span, pre-engineered, single arch modular bridges designed to cause no impediment on water flow and fish passage.

The road also crosses several smaller watercourses. Many of the existing culverts are in poor shape (crushed, blocked, and deteriorated) but where construction or drainage changes take place this will facilitate the restoration of the existing drainage conditions and improve fish passage where deemed appropriate.

6.3.6.3 Touquoy Processing and Tailings Management Facility

The Touquoy facility is currently under construction with full operation expected in Fall 2017. Tailings produced from processing Beaver Dam ore will be disposed of in the Touquoy open pit once this is fully exhausted of ore. Seepage from the deposited tailings will be recirculated through the processing facility in a closed loop during the period of processing Beaver Dam ore at the Touquoy facility. Once the Beaver Dam ore is finished being processed and the Touquoy pit begins to refill this recirculation will cease. Make up water requirements will be sourced from Scraggy Lake or other sources as per NSE approvals. The primary potential effect of the continued use of the Touquoy facility on surface water quality is the use of the exhausted open pit for tailings storage with possible seepage degrading surface water quality, and the potential for accidents and malfunctions. The Beaver Dam tailings will be managed in the exhausted Touquoy open pit mine. As originally planned in the approved Touquoy Gold Mine Project Reclamation Plan, the inflow of groundwater, surface flow and precipitation into the pit will naturally create a lake upon closure of the site.

The approved Touquoy Environmental Assessment stated that the pit would be allowed to fill naturally with water over a period of time through precipitation, surface flow and groundwater in-flow. No change to this method is planned following the deposition of Beaver Dam tails, except that the time frame for refilling will be shorter given the decrease in available volume taken by the tailings. There are no predicted or potential changes associated with physical aspects of the hydrology or hydrogeology for the Site.

There are potential impacts to surface water quality as a result of the storage of Beaver Dam tailings in the exhausted Touquoy open pit mine but it should be noted that these are restricted to the surface water in the exhausted pit only. The flooded pit will be a lake settling that is physically disconnected from the nearby Moose River.

Tailings will be subject to cyanide destruction at the process plant before flowing to the exhausted open pit. Previous works conducted during the Touquoy EARD and Focus Report identified that cyanide destruction to cyanate is proven 99.5% effective. Cyanate decomposes harmlessly. The majority of the residual cyanide reagent introduced to the tailings during ore processing will be degraded and hydrolyzed to carbon dioxide and ammonium during storage in the tailings pond. Similarly, this will be expected to occur for the Beaver Dam tailings being stored in the Touquoy open pit. Based on the results of testing conducted as part of the Feasibility Study, detoxification of the effluent will result in levels of copper and cyanide that are below the MMER limits (Ausenco 2015). Surface water quality data for the tailings management facility from the compliance program at Touquoy will be available to the AGC team. This will allow more refinement in the potential effects prediction for the Beaver Dam tailings deposition in the pit using over 7 years of data prior to the Beaver Dam tailings being introduced to the exhausted Touquoy pit. Surface water monitoring locations are provided on Figure 2.2-4.

Surface water quantity will be affected by the processing of the Beaver Dam ore at the Touquoy facility in that an additional period of surface water extraction will be required. The amounts for this surface water use and time period have been previously identified in this document. The use of surface water for industrial purposes is highly regulated in NS and involves a proponent making application to NSE and providing rationale for the use of the water and information on the lack of impacts associated with the water use. AGC is familiar with the process and will provide NSE with information associated with the extended water use period prior to the need for the extended period beyond the currently approved period for Touquoy operation.

There are no further effects to surface water quality or quantity anticipated to be caused by the processing of ore and the management of tailings from the Beaver Dam Mine Project. Surface water quality and quantity will continue to be monitored over the life of the Touquoy facility as part of existing approvals and any additional approval requirements for the currently approved life span of the facility and for the proposed extended life of the Touquoy site associated with processing of Beaver Dam ore. This is discussed further in Section 6.3.7.

6.3.7 Mitigation and Monitoring

6.3.7.1 Surface Water Quality

The following mitigation measures will be applied to reduce the potential environmental impacts of the Project on surface water at the Beaver Dam mine site and along the haul road:

- Sedimentation ponds will be utilized to treat water (TSP) from surface runoff and pit water. Treated water will be allowed to discharge to the environment;
- All surface water discharges from sedimentation ponds to the natural environment will be sampled as per requirements listed in industrial operating approvals and MMER to ensure water quality conforms to applicable guidelines;
- Stockpiles will employ perimeter ditches to direct water to ponds. Topographic controls will ensure that overflow form extreme weather conditions, should it occur, will be directed to the pit in to be treated later;
- An Erosion and Sediment Control Plan will prescribe stormwater management protocols during construction and operation;
- A Stormwater Management Plan will describe the construction and operation of drainage ditches and stormwater management ponds;
- Diesel fuel will be stored in double walled, aboveground storage tank with perimeter impact protection located on a concrete pad;
- An Emergency Response and Spill Contingency Plan will provide information on incident prevention, response procedures, and response training in the case of accidental spills; and
- Wetland Compensation Plan that describes an inspection and monitoring program for site and adjacent wetlands will be developed in collaboration with NSE.

Some collected water may be used for dust control, especially during dryer times.

If treated water effluent is discharged from the sedimentation ponds, water will be sampled and tested as described in the Surface Water Monitoring Plan. The laboratory analysis of the water sample will include those parameters required by NSE, MMER or any other parameters or conditions listed in the industrial operating approval. Where monitoring results exceed guideline values or approved discharge limits, a review of site activities will be undertaken to identify the source of exceedance and remedial measures will be implemented.

Atlantic Gold will repeat the same exercise of reviewing publicly available data and collecting current water quality data from the baseline stations, at a minimum, and other stations that may be added one year prior to initiating disruptive site development activities at Beaver Dam.

The Touquoy facility is currently under construction. Mitigation measures will be applied to reduce the potential environmental impacts of the Project on surface water at the Touquoy facility as per existing approvals. The placement of Beaver Dam tailings in the exhausted Touquoy open pit mine will occur over the course of approximately four years. Throughout this time, the pit will be slowly filling with water and ongoing monitoring will be occurring throughout the entire process. The existing IA for the Touquoy site identifies the following mitigation and monitoring elements related to surface water:

- Sixteen (16) surface water monitoring stations are established and monitored monthly for prescribed parameters, including metals, nutrients and other general water chemistry, like pH;
- These locations include natural watercourses both upstream and downstream of the facility, including Moose River, as well as the final facility effluent from the Touquoy TMF under the IA is also required under federal legislation, Metal Mining Effluent Regulations (MMER);
- Two permanent gauges in Moose River monitor flow both upstream and downstream of the facility;
- Surface water management and associated monitoring of the water drainage and collection is completed according to the plan submitted to NSE, such as volumes of tailings discharged to the TMF and water levels in the TMF;
- Water withdrawal from Scraggy Lake for plant operational requirements is monitored in terms of flowrate and water levels in the lake as per existing approvals; and
- Records of surface water balances, surface water monitoring and any corrective actions will be submitted to NSE in the annual report; however, any non-compliance is identified to NSE in timely fashion as per the IA.

It is anticipated that the future IA for Beaver Dam Mine Project will have similar requirements for mitigation and monitoring related to potential environmental effects of the Project activities. The collection of this data prior to operational activities relative to the Beaver Dam Mine Project provides additional baseline data (that support the anticipated mitigation measures and follow up and monitoring programs. These surface water monitoring locations are provided on Figure 2.2-4.

Additionally, an EEM is in place for the Touquoy facility. This EEM program provides data collection that would be expected to continue throughout the life of the Touquoy facility and provides information useful in impact assessment and mitigation.

Surface water quantity impacts anticipated by the processing of the Beaver Dam ore at the Touquoy facility include an additional four year period of surface water extraction that will be required. All surface water extractions are done through an approvals process administered by NSE.

Table 6.3-17 Mitigation and Monitoring Program for Surface Water Quality

Project Activity	Mitigation Measures	Monitoring Program
Site Preparation and Construction, Operation / Maintenance, and Decommissioning/ Reclamation	Sedimentation ponds and perimeter ditches Erosion and Sediment Control Plan Stormwater Management Plan	• The MMER program will involve more detailed surface water sampling as well as site effluent sampling to determine final EEM program components, locations, frequency and parameters to be sampled for as well as possible species involved in the EEM. • Surface water quality monitoring at select baseline sampling locations on the mine site and the haul road to compare data to applicable guidelines and baseline data. • Surface water quality monitoring will continue at the Touquoy facility at the sixteen surface water monitoring locations currently in place. • Monitored discharge guided by a Surface Water Monitoring Plan • Annual review of program and the need for revisions based on baseline data comparison and discussions with regulators
	Wetlands Compensation Plan	Inspection and Monitoring Plan that includes hydrologic flow analysis
	Emergency Response Spill Contingency Plan	Emergency Spill Response Training, Annual updates
	Double walled, aboveground diesel storage tank	Weekly inspections of supply and barriers

6.3.8 Residual Effects and Significance

Pollution prevention measures will be employed at the site to prevent accidental spills. Runoff from the surface mine workings will flow to sediment retention ponds. The ponds will allow the water to be reused on-site for dust control. Discharges to the environment will occur at defined locations that can be sampled and tested to ensure the applicable discharge standards are achieved. Thus, the predicted residual adverse impacts on surface water are not expected to be significant.

Stripping of vegetation and soils from the operational areas is expected to increase the mean annual runoff discharged from the site. Much of this will flow towards Cameron Flowage/Killag River as is currently the case. Given this, the impacts on nearby surface water resources and associated downstream aquatic ecosystems are not considered to be significant. Diversion of flows into perimeter ditches and sedimentation ponds will reduce flows. The impacts of any changes will be felt slowly as the mine development proceeds. Given that these potential changes in surface flow to the flowage are relatively minor and short term for mining operations, the impacts of these effects are not considered to be significant.

Changes to surface water quantity are not anticipated at the Touquoy facility as a result of the processing of Beaver Dam ore. The deposition of Beaver Dam tailings into the exhausted Touquoy open pit mine could potentially impact the quality of the water in the shallow lake that will be created in the open pit; however, based on work previously completed for the Touquoy facility, effects on surface water chemistry are not anticipated to be significant, once mitigation measures have been applied.

The overall residual effect of the Project on surface water is assessed as not significant after mitigation measures have been implemented.

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Table 6.3-18 Residual Environmental Effects for Surface Water

Project - VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
Clearing and grubbing (reduced infiltration)	Sediment and erosion control, reclamation during decommissioning and best management practices.	A	M	PA	LT	R	R	MD	Disturbance, Habitat Loss	Not Significant
Heavy machinery operation (impacts to water quality from dust, sediments, accidents and contamination)	Sediment and erosion control, spill preparedness and best management practices	A	M	PA	ST	R	R	LD	Disturbance	Not Significant
Direct surface waterbody alteration (infilling, draining, flooding, altering function, altering groundwater recharge capacity)	Engage watercourse alteration permitting process Surface water monitoring and compensation	A	M	PA	P	O	IR	LD	Habitat Loss Disturbance	Not Significant
In-direct surface waterbody alteration (water quality, hydrological imbalance, sedimentation)	Surface water monitoring and compensation	A	L	LAA	M	S	R	LD	Disturbance	Not Significant
Widening and new haul road construction (hydrological changes, surface	Engage watercourse alteration permitting process Surface water monitoring	A	L	PA	P	O	IR	LD	Habitat Loss Disturbance	Not Significant

Table 6.3-18 Residual Environmental Effects for Surface Water

Project - VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
water body alteration and vegetation removal)										
Blasting and drilling of in-situ rock	Pre-blasting plan and evaluation of potential to indirectly impact surface water.	A	L	PA	ST	R	R	LD	Disturbance	Not Significant
Storage of Beaver Dam tailings in the Touquoy open pit mine	Surface water monitoring	A	M	PA	P	R	IR	LD	Disturbance	Not Significant

Legend (refer to Table 5.10-1 for definitions)

Nature of Effect		Geographic Extent		Frequency		Ecological and Social Context	
A	Adverse	PA	Project Area	O	Once	LD	Low Disturbance
P	Positive	LAA	Local Assessment Area	S	Sporadic	MD	Moderate Disturbance
		RAA Area	Regional Assessment	R	Regular	HD	High Disturbance
Magnitude				C	Continuous		
N	Negligible						
L	Low	Duration		Reversibility			
M	Moderate	ST	Short-Term	R	Reversible		
H	High	MT	Medium-Term	IR	Irreversible		
		LT	Long-Term				
		P	Permanent				

6.3.9 Proposed Compliance and Effects Monitoring Program

As the Project moves forward, monitoring programs will proceed to gather pre-construction surface water baseline data. Monitoring programs will continue during construction, operation, and post-production to verify baseline conditions and to determine the effects of the Project on the surface water environment. Table 6.3-17 summarizes the mitigation and monitoring activities that will be completed throughout the life of the Project. The MMER program would involve more detailed sediment and surface water sampling as well as site effluent sampling to determine final EEM program components, locations, frequency and parameters to be sampled for as well as possible species involved in the EEM. The details of the monitoring programs will be determined in consultation with regulatory agencies and will be described in the application for an IA for the site operations following the EA process. High level detail is needed in this application and would be subject to review by NSE and other agencies. An EMS and EPP will be developed as part of the Project implementation that will confirm the responsibility and system of accountability for the compliance and effects monitoring program.

The objectives of the surface water monitoring programs are to:

- Verify effects predicted in the EIS;
- Confirm the continuing effectiveness of mitigation measures;
- Identify the need for any new mitigation measures; and
- Confirm compliance with regulatory approvals and requirements.

The surface water monitoring program will include the following, as well as additional monitoring as determined through discussions with regulatory agencies:

- Surface water quality monitoring at select baseline sampling locations on the mine site and the haul road;
- The MMER program would involve more detailed surface water sampling as well as site effluent sampling to determine final EEM specifications;
- Monitored discharge of surface water; and
- Ongoing surface water quality monitoring at the Touquoy facility.

6.4 Groundwater Quality and Quantity

6.4.1 Rationale for Valued Component Selection

Groundwater quality and quantity is provincially regulated via many legislative avenues within the *Environmental Act* and protects ecological components, as well as the health of the general public.

Groundwater quality and quantity as a VC is centered on its potential ecological value in recharging surface water and wetlands. From a hydrological and hydrogeological perspective, the potential disconnection between bedrock aquifers and surface water in the project area may limit groundwater recharging or being recharged by surface water. In a mine dewatering scenario, groundwater may experience draw down and subsequently adversely affect surface water quantity in Cameron Flowage or adjacent wetlands. Groundwater as a VC is also included in this EIS relative to the Touquoy operation as that pit is being used for Beaver Dam tailings deposition.

Groundwater quality and quantity also has a socio-economic importance due to its potential to provide potable water through drilled and dug wells. The nearest domestic well is approximately 5.5 km southwest of the Beaver Dam mine site.

6.4.2 Baseline Program Methodology

The Beaver Dam mine site is in an area of Nova Scotia that has been well studied from a geology and hydrogeology perspective. Publically available information is abundant including important studies such as Lin 1970. The NS Well Log Database which contains thousands of records of wells drilled and dug in Nova Scotia was reviewed to determine the proximity and construction details for domestic wells in the area of the mine site. Data was reviewed for applicability to the Beaver Dam mine site geology and hydrogeology and was used in the assessment of this VC. Hydrogeological maps and cross-sections for the mine area do not exist in the public domain but are well understood from past drilling programs. The stratigraphy and general hydrogeological conditions have been described in this document in Section 6.2.

Peter Clifton & Associates completed a hydrogeological assessment of the Touquoy Site. The report provides an assessment of potential groundwater inflows to the proposed open pit at the Touquoy site. This assessment used a series of geotechnical/hydrogeological drill holes that were also sampled for groundwater quality. The holes were purged using an airlift method and then sampled after fully developing and purging the wells to obtain a representative groundwater sample. The water obtained from the drill holes represents groundwater from bedrock at the site. Samples were analyzed for general chemistry and metals. Test pits were also excavated in June 2006 to evaluate groundwater flow in the till between the open pit and Moose River. Additional assessment work completed in September 2006 included a temperature survey of surface water to determine possible areas of upwelling groundwater. A series of multi-level wells were installed at the Touquoy site and since 2016, groundwater monitoring has been ongoing at the Touquoy site per regulatory requirements. This has included 32 pairs of multi-depth (level) monitoring wells to outline overburden and bedrock conditions (water levels and chemistry).

Peter Clifton & Associates also completed a hydrogeological assessment of the Beaver Dam Mine site (Peter Clifton & Associates, 2015**.** The report provides an assessment of potential groundwater inflows to the proposed open pit at the Mine site, and included a review of previous hydrogeological investigations completed at the Mine site by Jacques Whitford and Associates Limited in 1986 and Stantec Consulting Ltd. in 2014. The Peter Clifton and Jacques Whitford reports are included in **Appendix E.**

The historic and recent data from the site provided a complete picture of the physical hydrogeology of the site as well as possible interactions that were examined as part of the groundwater VC. A conceptual model of the site that shows a topographically controlled groundwater system with abundant shallow groundwater and surface water interactions was developed. Additional modelling (numeric or otherwise) was not completed as the primary outcome of the work outlined above indicated that some interaction would occur and that a focus on determination of the interaction with wetlands and surface water (Cameron Flowage) was needed in this VC assessment. This resulted in a shallow well point program being completed involving multiple locations (9) within a kilometre of the proposed pit and stockpile areas to further understand the shallow groundwater and surface water relationship.

The Beaver Dam hydrogeologic conditions are very similar in nature to those at the Touquoy site. The understanding of the groundwater system at Beaver Dam will therefore grow with the collection and analysis of data from the compliance monitoring program at Touquoy that has been ongoing since the spring of 2016. By the time activities are underway at the Beaver Dam mine site which may affect groundwater there will be up to 7 years of groundwater data and analysis available from the Touquoy mine site that can be used in final planning for Beaver Dam. Relationships between surface water and groundwater systems at Touquoy that will be better understood in these intervening years and this knowledge will be applied to the monitoring and data collection programs for the Beaver Dam mine site throughout the construction, operation, and reclamation phases. Empirical data has a significant value in this situation and will be used to the fullest extent, and preferentially over modelling.

6.4.3 Baseline Conditions

The site is located in a rural, sparsely populated area of Halifax County. The nearest domestic well is 5.5 kilometres southwest from and up-gradient of the Beaver Dam mine site, at a residence along Hwy 224. Domestic wells located along Hwy 224 are a mix of drilled and dug wells based on a review of the NS Well Log Database. Some of the drilled wells in the Well Log Database are reported as completed in granite (which is not mapped for the area by NSDNR) so they may not be representative of the hydrogeologic conditions in the fractured slates and quartzite of the bedrock beneath the Site. Drilled wells are often over 60 m deep, are typically fed by one or two sets of discrete water-bearing fractures and have relatively low yields, typically 5 to 10 L/min. Static groundwater levels range from 3 m to 12 m bgs. Domestic water supplies in the area are typically vulnerable to surface water entry and associated coliform bacteria issues and elevated iron and manganese concentrations (Lin 1970). Tables 6.4-1 and 6.4-2 below summarize the water quality identified in nearby drilled and dug wells.

Table 6.4-1 Till Groundwater Analysis for dug well in area of site

Parameter	CDWQ Guidelines	CDWQ Source	Units	Dug Well
Sodium	200	AO	mg/L	2.0
Potassium			mg/L	0.3
Calcium			mg/L	21.0
Magnesium			mg/L	3.5
Hardness (CaCO3)			mg/L	67.0
Alkalinity (CaCO3)			mg/L	40.7
Sulfate	500	AO	mg/L	22.0
Chloride	250	AO	mg/L	6.4
Silica			mg/L	3.9
Orthophosphate			mg/L	<0.01
Nitrate + Nitrite			mg/L	0.12
Ammonia			mg/L	<0.5
Arsenic	0.01	MAC	mg/L	0.04
Iron	0.3	AO	mg/L	2.3
Manganese	0.05	AO	mg/L	0.25

Table 6.4-1 Till Groundwater Analysis for dug well in area of site

Parameter	CDWQ Guidelines	CDWQ Source	Units	Dug Well
Lead	0.010	MAC	mg/L	0.009
Copper	1	AO	mg/L	0.01
Zinc	5	AO	mg/L	0.03
Total Dissolved Solids	500	AO	mg/L	84.0
Suspended Solids			mg/L	382
Colour	15	AO	TCU	12.5
Turbidity			NTU	87
Conductivity			umho/cm	149.0
pH	7.0 - 10.5	AO	S.U.	6.8

Notes:

The Dug well was partially constructed of waste rock and the sample was turbid so it may not be representative of metals in the overburden groundwater.

CDWQ: Health Canada's Guidelines for Canadian Drinking Water Quality, October 2014

AO Aesthetic Objective

MAC Maximum Acceptable Concentration

Red denotes guideline exceedance

Table 6.4-2 Bedrock Groundwater Analysis for drilled wells in area of site

Parameter	CDWQ Guidelines	CDWQ Source	Units	Austin Shaft 7m	Austin Shaft 17m	DDH86-47 (flowing)1
Sodium	200	AO	mg/L	2.1	2.3	4.4
Potassium			mg/L	0.9	0.8	1.4
Calcium			mg/L	8.3	9.5	24.3
Magnesium			mg/L	1.0	1.1	2.0
Hardness (CaCO3)			mg/L	25.0	28.3	69.0
Alkalinity (CaCO3)			mg/L	20.3	23.5	69.0
Sulfate	500	AO	mg/L	8.0	8.0	7.5
Chloride	250	AO	mg/L	3.3	3.1	4.6
Silica			mg/L	4.8	5.2	12.0
Orthophosphate			mg/L	0.02	<0.01	0.01
Nitrate + Nitrite			mg/L	0.18	0.13	<0.5
Ammonia			mg/L	<0.05	<0.05	<0.5
Arsenic	0.01	MAC	mg/L	0.04	0.04	0.04
Iron	0.3	AO	mg/L	0.3	0.32	0.5
Manganese	0.05	AO	mg/L	<0.01	0.03	0.31
Lead	0.010	MAC	mg/L	<0.002	<0.002	<0.002

Table 6.4-2 Bedrock Groundwater Analysis for drilled wells in area of site

Parameter	CDWQ Guidelines	CDWQ Source	Units	Austin Shaft 7m	Austin Shaft 17m	DDH86-47 (flowing)1
Copper	1	AO	mg/L	<0.01	<0.01	<0.01
Zinc	5	AO	mg/L	<0.01	<0.01	<0.01
Total Dissolved Solids	500	AO	mg/L	35.0	43.0	94.0
Suspended Solids			mg/L	<0.3	<0.3	0.8
Colour	15	AO	TCU	5.0	5.0	20
Turbidity			NTU	1.5	2.3	0.4
Conductivity			umho/cm	69.00	76.00	161.0
pH	7.0 - 10.5	AO	S.U.	6.30	6.40	7.4
Aluminum	0.1	AO	mg/L	<0.05	<0.05	- -
Boron	5	MAC	mg/L	<0.02	<0.02	- -
Barium	1	MAC	mg/L	<0.005	<0.005	- -
Beryllium			mg/L	<0.005	<0.005	- -
Chromium	0.05	MAC	mg/L	<0.01	<0.01	- -
Cobalt			mg/L	<0.01	<0.01	- -
Nickel			mg/L	<0.02	<0.02	- -
Antimony	0.006	MAC	mg/L	<0.05	<0.05	- -
Selenium	0.05	MAC	mg/L	<0.1	<0.1	- -
Tin			mg/L	<0.03	<0.03	- -
Vanadium			mg/L	<0.01	<0.01	- -
Mercury	0.001	MAC	mg/L	<0.05	<0.05	- -
Cadmium	0.005	MAC	mg/L	<0.01	<0.01	- -

Notes:

1Sample taken from exploration borehole but representative of typical bedrock groundwater of site area.

CDWQ: Health Canada's Guidelines for Canadian Drinking Water Quality, October 2014

AO Aesthetic Objective

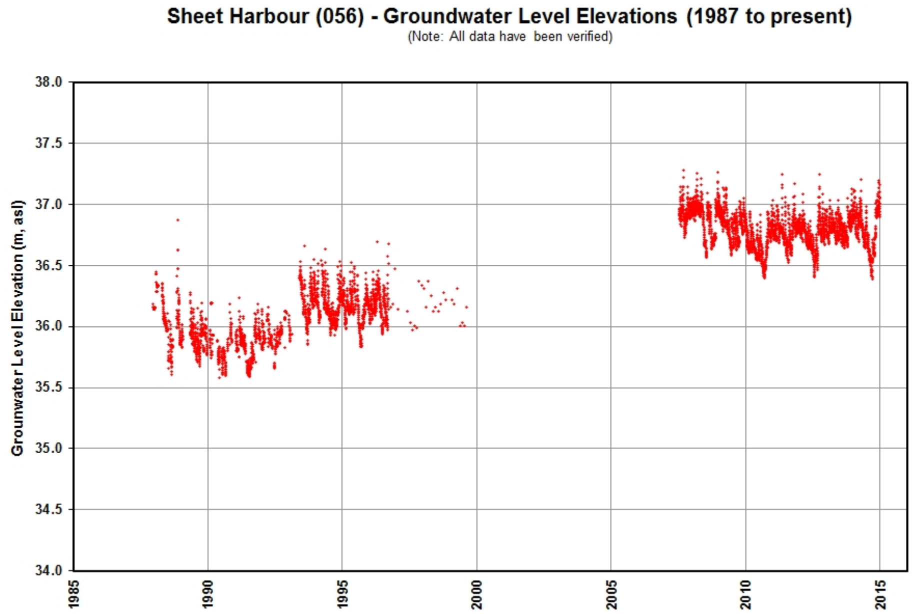
MAC Maximum Acceptable Concentration

Red denotes guideline exceedance

It should be noted that the rock at the Beaver Dam site was determined through testing to be net acid consuming. The likelihood of acidic runoff being generated and the occurrence of associated issues with metals-enriched runoff is therefore very limited. Groundwater in contact with the net acid consuming materials will not generate acidic groundwater that may enter the surface water system. Areas where the rock is net producing are well understood and the available data to properly manage this material increase during mining as testing is completed as the project advances.

In relation to the Touquoy mine site, Camp Kidston, which operates only in the summer months, is located 3.5 km northeast of the Touquoy facility. According to the Proponent, the nearest permanent full-time occupied residences are located approximately 5.8 km to the north of the Touquoy open pit along Caribou Road. The next closest permanent residences to the Touquoy processing and tailings management facility are approximately 7.4 km to the northwest and 11.7 km to the southeast.

A review of the Nova Scotia Groundwater Observation Well Network 2015 report identifies that there are two observation wells located in the general vicinity of the PA, in Sheet Harbour and Musquodoboit Harbour. This is the most recent report completed under this program. The report identifies that in general across the province, aquifers have higher water levels in the spring months and lower levels in the summer months. The typical seasonal variation in groundwater levels in Nova Scotia aquifers is usually less than about three metres. Lower water levels may also be observed in February, depending on winter conditions including snowfall amounts and frost, which can limit recharge. Trend analysis has not been conducted on the two nearest observation wells in this network due to insufficient data collected to date (less than 10 years of usable data). In general, water levels have remained relatively consistent at the Musquodoboit Harbour observation well since its installation in 2008, and water levels have increased by approximately 1 metre in the Sheet Harbour observation well since its installation in 1987. Figures 6.4-1 and 6.4-2 below provide a summary of the groundwater elevations observed in these two observation wells.



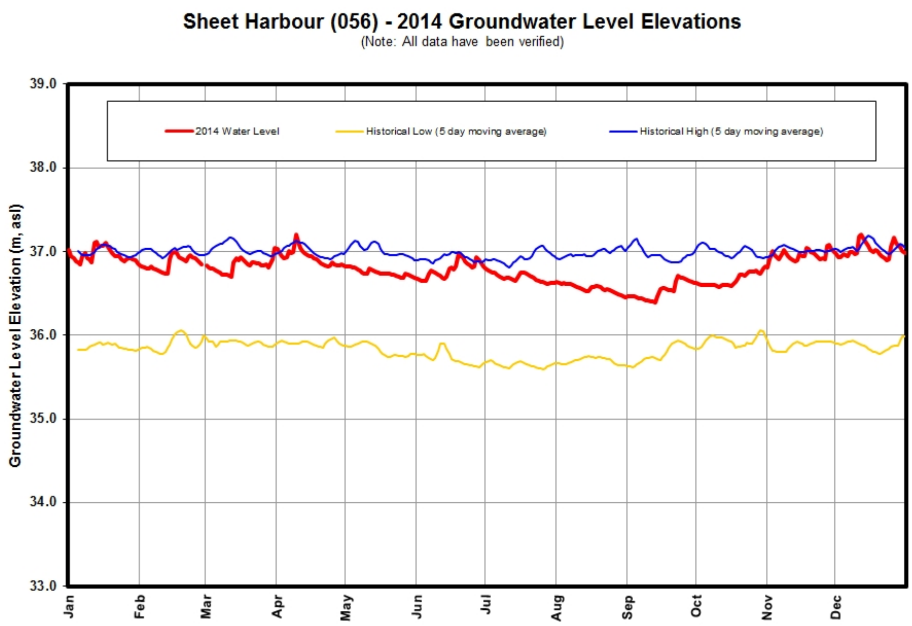


Figure 6.4-1 Summary of Groundwater Elevations Observed in Sheet Harbour Observation Well (NSE 2015c)

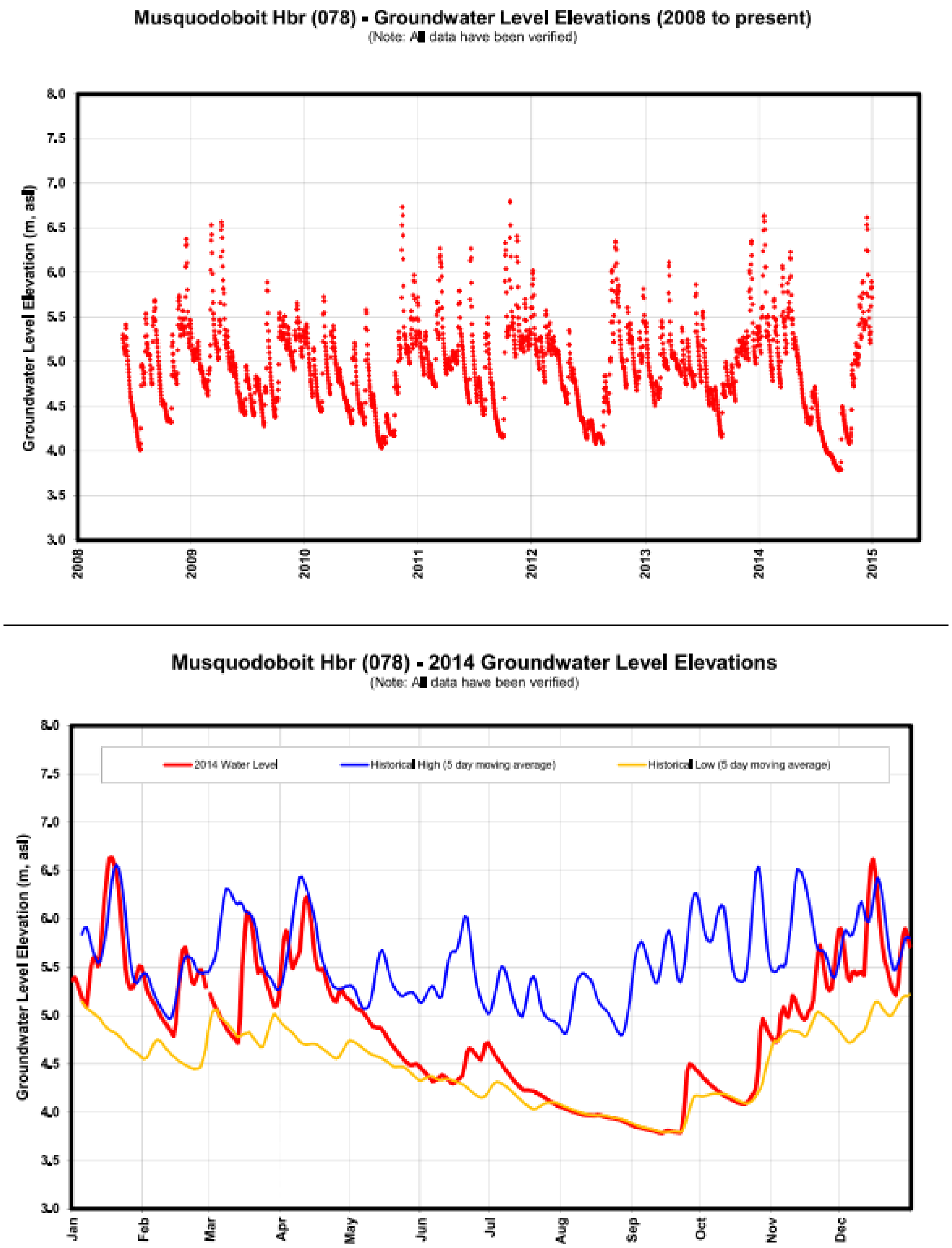


Figure 6.4-2 Summary of Groundwater Elevations Observed in Musquodoboit Harbour Observation Well (NSE 2015c)

Test pumping of a well installed in the till in the PA indicates the till has a hydraulic conductivity of 1.5×10^{-2} centimetres per second (cm/sec). Transmissivity was calculated at 4.85 metres squared per day (m^2/day) and the long term safe well yield was estimated at 6.8 litres per minute (L/min).

6.4.3.1 Hydrogeology

The site hydrogeology in the PA consists of a fractured rock aquifer system, which is overlain by a thin till layer. These two hydrogeologic units are present on a regional scale and extend beyond the limits of the mine site. Most of the site specific hydrogeologic data collected to date were focused on determining the rate of groundwater flow in bedrock in order to determine dewatering requirements.

The till at the Site is orange brown to olive brown silty sand and gravel. It contains quartzite and slate cobbles and bounders up to 1 m in diameter. Grain size analysis indicates the till averages approximately 60 percent gravel, 25 percent sand, 15 percent silt, and one percent clay. Site topography is relatively flat and till thickness is controlled by the depth to the undulating bedrock surface. Till thickness ranges from 1 m to 22 m but is typically 3 m to 5 m think.

The degree of saturation of the till varies. A series of test pits installed at the Beaver Dam mine site encountered groundwater a 0.6 m below ground surface (bgs) but this was close to a bog area and could be a perched water table. The water table was encountered at depths of 1.5 to 1.8 m bgs in several test pits but others were terminated on bedrock at depths of up to 4 m without encountering groundwater. Groundwater flow in the till likely mimics the topography, with recharge occurring in elevated areas and groundwater flowing towards and discharging into local surface water bodies.

The till, as well as bedrock, will have temporal variations in flow and water levels based on rainfall and infiltration. These can be highly variable due to the local and regional weather which can affect frozen ground periods and dry periods where no infiltration occurs, for example. Seepage rates from the till are expected to be greatest following the spring thaw and during the early summer months.

6.4.3.2 Beaver Dam Mine Site

Jacques, Whitford and Associates conducted a hydrogeological investigation at the Beaver Dam site in 1986 and Stantec Consulting Ltd. conducted a hydrogeological investigation in 2014. Based on the results of pumping tests and packer tests, the geometric mean value of all of the hydraulic conductivity results from the 1986 and 2014 testing programs is relatively small, at 4.5×10^{-8} m/sec. The results of extensive packer testing of the bedrock at Beaver Dam did not identify any large-scale permeable units from which large rates of groundwater seepage into an open pit could be expected. The geometric mean (approximate median) value of the entire set of hydraulic conductivity values determined from these tests is 4.5×10^{-8} m/sec. This is a relatively small value of this parameter; however, this is consistent with the lithology of the sequence at Beaver Dam apparent from diamond cores.

Jacques Whitford and Associates reported that during site work completed in the 1980s, most of the diamond drill holes had static groundwater levels with 0.3 m of ground surface. Drill holes that penetrated the Mud Lake Faults zone were often flowing, albeit at very low rates (less than 5 L/min). This indicates an area where bedrock groundwater is discharging upward into the overlying wetland systems. The same observation was made by GHD during field work completed to outline the surface water-groundwater interaction, which included the installation of well points at select locations where groundwater discharge was suspected, to outline the groundwater-surface water relationships at the site.

Table 6.4-3 Groundwater-Surface Water Interactions Table

Location ID	Description	GPS Coordinates	Rationale for Location	Results Summary	Notes
Location #1 Wellpoint and SED1	Downstream of site on Cameron Flowage	523247 4990039	To assess interaction between Cameron Flowage and local groundwater system down gradient of site	Delta of 4 cm indicates slight downward gradient from stream to groundwater system. Cameron Flowage has minor contribution to local groundwater system at this location.	Inspection completed of stream bank to 100 metres from well point site up-gradient and down-gradient with no seepage points noted or up-welling in stream bed obvious. Stream has bedrock exposed and cobbles with coarse sand bottom.
Location #2 Wellpoint and SED2	Upstream of site, west bank of Cameron Flowage	521989 4990921	To assess interaction between Cameron Flowage and groundwater system at this location up-stream of mine area	No delta in levels inside and outside well point at this location indicating no groundwater and surface water interaction	Inspection completed of stream bank to 100 metres from well point site up-gradient and down-gradient with no seepage points noted or up-welling in stream bed obvious. Stream has coarse sand and cobble substrate with minor sands.
Location #3 Wellpoint and SED3	Down-gradient from planned Waste Rock Pile	521560 4990242	To assess interaction between groundwater and surface water at this location.	No delta in levels inside and outside well point at this location indicating no groundwater and surface water interaction	No visible areas of discharge noted within 50 metres of site up-gradient and down-gradient. Stream has gravelly cobble substrate with some silt and boulders.
Location #4 Wellpoint and SED4	Down-gradient from planned Waste Rock Pile	521941 4990172	To assess interaction between groundwater and surface water at this location.	Delta of 6 cm indicates slight downward gradient from stream to groundwater at this location.	No visible areas of discharge noted within 40 metres of site up-gradient and down-gradient. Stream has an organic substrate underlain by silty sand with some cobbles.
Location #5 Wellpoint and SED5	Down-gradient from planned Waste Rock Pile	521829 4990207	To assess interaction between groundwater and surface water at this location.	No delta in levels inside and outside well point at this location indicating no groundwater and surface water interaction	No visible areas of discharge noted within 50 metres of site up-gradient and down-gradient. Stream has an organic substrate underlain by silty sand with some cobbles.
Location #6 Wellpoint and SED6	Down-gradient from Cameron Flowage	522960 4990277	To assess interaction between groundwater and surface water at this location.	Delta of 3 cm indicates slight downward gradient from stream to groundwater at this location.	No visible areas of discharge noted within 50 metres of site up-gradient and down-gradient. Stream has a silt substrate with organics and some boulders.
Location #7 Wellpoint and SED7	Downstream of planned facilities, ore storage, and crushing facilities	522730 4990130	To assess interaction between groundwater and surface water at this location.	No delta in levels inside and outside well point at this location indicating no groundwater and surface water interaction	No visible areas of discharge noted within 60 metres of site up-gradient and down-gradient. Stream has a silt substrate with minor organics and some boulders and cobbles.
Location #8 Wellpoint and SED8	Downstream of planned Waste Rock Pile	522658 4989053	To assess interaction between groundwater and surface water at this location.	No delta in levels inside and outside well point at this location indicating no groundwater and surface water interaction	No visible areas of discharge noted within 40 metres of site up-gradient and down-gradient. Stream has a silt substrate with heavy organics and boulders, minor cobbles.
Location #9 Wellpoint and SED9	Downstream of planned Waste Rock Pile	521841 4989133	To assess interaction between groundwater and surface water at this location.	No delta in levels inside and outside well point at this location indicating no groundwater and surface water interaction	No visible areas of discharge noted within 50 metres of site up-gradient and down-gradient. Stream has a silt substrate with organics.

Based on previous studies of the hydrogeology of this deposit and others in the area the degree of hydraulic connection amongst the smaller bedrock fracture systems is likely poor to moderate, and the main zones that are capable of storing and transmitting relatively large amounts of groundwater are the larger scale faults. The water table is close to the surface across the Beaver Dam site, reflecting flat lying terrain, low permeability bedrock and the excess of annual rainfall over evaporation. Thus, the bedrock sequence and part of the overlying tills will be saturated with groundwater under ambient conditions.

The structure of the bedrock at the site consists of three sub-parallel anticlines and the gold deposit is associated beds that dip to the north at between 75° and 90°. The Mud Lake Fault and the Cameron Flowage Fault trend northwest near the Site. The Mud Lake Fault is described from drill cores as a 2 m to 3 m zone of gouge within a 10 m to 20 m wide brecciated zone. Locally, bedrock groundwater flows predominantly southeast along the fault trends, with flows to the northeast and east directions caused by secondary structural features. Fractures noted evidence of groundwater movement (iron staining) but were small in spacing and orientations varied depending on which side of the anticline and the strata's proximity to Mud Lake Fault.

The hydraulic conductivity values determined by packer testing bedrock boreholes ranged from 3.7×10^{10} m/sec to 1.9×10^{-6} m/sec. The geometric mean of all the bedrock hydraulic conductivity values is 4.5×10^{-8} m/sec. Five of the 1986 hydraulic conductivity values determined from borehole intervals that intersected the Mud Lake Fault ranged from 1.2×10^{-9} m/sec to 1.9×10^{-6} m/sec with a geometric mean of 1.5×10^{-8} m/sec, which is not significantly greater than values measure outside the fault zone.

The 2015 Peter Clifton & Associates Ltd. report indicates that groundwater occurs at shallow depths at the Beaver Dam Mine site. Cameron Flowage is likely an area of groundwater discharge. The bedrock sequence forms a fractured rock aquifer system, and this is overlain by a thin aquifer in the till. The degree of hydraulic connection amongst the smaller bedrock fracture systems is probably poor to moderate, and the main zones that are capable of storing and transmitting relatively large amounts of groundwater would be the larger scale faults. The volume of groundwater stored in the bedrock aquifer is probably small, and this reflects the relatively small primary porosity of these rocks. Some of the larger bedrock structures may be hydraulically connected to surface water bodies which may become sources of aquifer recharge under a mine dewatering scenario.

Groundwater can be expected to seep into an open pit developed at the Beaver Dam site through the surficial glacial till deposits, and through fractures and structures in the bedrock. As dewatering progresses and groundwater levels in the vicinity of the open pit are lowered, some surface water bodies which are presently groundwater discharge areas may become areas of groundwater recharge.

6.4.3.3 Touquoy Gold Mine

Results from groundwater monitoring at the Touquoy property indicate that the groundwater is slightly basic (pH range 7.02 to 8.08) and an elevated hardness (45- 160 mg/L). Certain metals such as aluminum, arsenic, manganese, strontium and zinc are elevated relative to guidelines for drinking water in Canada but within ranges found in groundwater in Nova Scotia. The actual volume of groundwater stored in the bedrock aquifer is small, and this reflects the relatively small primary porosity of these rocks. Given that the geology at Beaver Dam is similar to that at the

Touquoy site, it is anticipated that similar hydrogeological conditions exist across the entire Project area.

The test pitting program identified that the expected rates of groundwater seepage from the till into the open pit at Touquoy will be small, likely between 100 kL/day to 1,000 kL/day. An additional assessment completed as part of the Focus Report to determine the potential linkage between Moose River and the local groundwater system identified that groundwater upwelling is not occurring through the portion of Moose River that lies adjacent to the proposed Touquoy open pit.

As identified in the 2007 Focus Report, The Touquoy mine is located within a metamorphic (bedrock) hydrostratigraphic unit, possibly cross cutting active structural (faults, anticlinal axes) hydrostratigraphic units. Groundwater inflows and outflows will be controlled by these relatively low permeability and fracture controlled units. Given the high water table in the study area and combined with the high water surplus and general low permeability of the area, the groundwater flow system can be characterized as a "Local" system, with topographic highs representing recharge zones that would discharge into the adjacent topographic lows. The till overburden hydrostratigraphic unit is expected to create non-flowing artesian conditions within the bedrock. Groundwater-stream interaction is expected to be controlled by the thickness, continuity and permeability of the confining till.

Under ambient conditions, surface water contribution to groundwater would be very limited given the thickness, continuity and permeability of the confining till and the relative impermeability of the bedrock.

6.4.4 Consideration of Consultation and Engagement Results

Key issues raised during public consultation and Mi'kmaq engagement relating to groundwater include potential effects on groundwater levels from mining the pit at Beaver Dam and groundwater quality associated with Project activities at the both the Beaver Dam Mine site and the Touquoy Gold Mine site. Concerns were specifically expressed by Millbrook First Nation regarding effects on groundwater quality and quantity in terms of potable water wells and the health of its residents in Beaver Lake. Questions were identified related to potential effects on groundwater of unplanned releases due to accidents and malfunctions, specifically during operation.

The results of the public consultation and Mi'kmaq engagement have been considered in the environmental effects assessment, including the Proponent's commitments on mitigation and monitoring measures and proposed compliance and effects monitoring programs, as well as the Proponent's broader commitment to ongoing public consultation and Mi'kmaq engagement. Specific to evaluating the effect on groundwater quality and quantity, these are found within the following environmental effects assessment.

6.4.5 Effects Assessment Methodology

6.4.5.1 Boundaries

Spatial Boundaries

The spatial boundary used for the assessment of effects to groundwater quality and quantity is the RAA. As the Project has the potential to cause direct and indirect effects to groundwater quality and quantity, as well as causing cumulative effects compounded spatially and temporally from other Projects, the RAA is the most appropriate spatial boundary.

The RAA in the context of groundwater quality and quantity is limited to groundwater and surface watersheds in and immediately adjacent to the PA.

Temporal Boundaries

The temporal boundaries used for the assessment of effects to surface water quality and quantity are the construction phase, operational phase, and decommissioning and reclamation phase.

Technical Boundaries

No technical boundaries were identified for the effects assessment of groundwater quality and quantity.

Administrative Boundaries

Groundwater quality on the mine site and along the haul road will be compared to criteria from the CCME groundwater quality criteria. There may be other requirements for monitoring of groundwater through provincial approvals to be obtained prior to the start of the Project.

6.4.5.2 Thresholds for Determination of Significance

A significant adverse effect from the Project on groundwater is defined as an effect that is likely to cause effects on groundwater quality or quantity. An effect on groundwater quality would include exceeding the applicable CCME groundwater quality criteria. Effects on groundwater quantity would include causing significant groundwater draw down, which would limit the ability of groundwater to recharge Cameron Flowage to the extent that habitat or species are affected or affects to wetlands with reduced water due to groundwater movement to the pit area.

6.4.6 Project Activities and Groundwater Quality and Quantity Interactions and Effects

Potential interaction between Project activities and groundwater quality and quantity within the PA is outlined in Tables 6.4-4 to 6.4-6 below and in the Surface Water and Groundwater Interaction Table provided in Table 6.4-3, presented above.

Table 6.4-4 Potential Groundwater Interactions with Project Activities at Beaver Dam Mine Site

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Clearing, grubbing, and grading in preparation of construction • Rock blasting in preparation of construction • Existing settling pond dewatering in preparation of construction • Watercourse and wetland alteration in preparation of construction • Mine site road construction • Surface infrastructure installation and construction • Collection and settling pond construction • Environmental monitoring of groundwater • Accidents and malfunctions to include fuel and other spills, forest fires, settling pond overflow, slope failure, and mobile equipment accidents
Operation and Maintenance	3-4 years	• Rock blasting to access and extract ore • Surface mine dewatering to facilitate access to and extraction of ore • Management of waste rock produced from crushing and preparing ore for transport • Treatment of site surface water runoff and surface mine pumped water • Petroleum products management • Environmental monitoring (water level and chemistry) of groundwater. • Accidents and malfunctions to include fuel and other spills, forest fires, settling pond overflow, slope failure, and mobile equipment accidents
Decommissioning and Reclamation	1-2 years	• Site Reclamation • Environmental Monitoring • Accidents and malfunctions to include fuel and other spills, forest fires, settling pond overflow, slope failure, and mobile equipment accidents

Table 6.4-5 Potential Groundwater Interactions with Project Activities along Haul Road

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Clearing, grubbing, and grading in preparation of construction • Rock blasting in preparation of construction • Watercourse and wetland alteration in preparation of construction • Watercourse and wetland alteration in preparation of construction • Haul road construction and upgrades • Environmental monitoring of adjacent wetlands • Accidents and malfunctions to include fuel and other spills, forest fires, and mobile equipment accidents
Operation and Maintenance	3-4 years	• Ore transport • Haul road maintenance and repairs including salt • Environmental monitoring of adjacent wetlands • Accidents and malfunctions to include fuel and other spills, forest fires, and a haul truck accident
Decommissioning and Reclamation		N/A[1]

1 Decommissioning and Reclamation of the haul road is not expected. The haul road will be returned to owner for forestry uses as owner determines

Table 6.4-6 Potential Groundwater Interactions with Project Activities at Touquoy Processing and Tailings Management Facility

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Accidents and malfunctions to include fuel and other spills, forest fires, and mobile equipment accidents
Operation and Maintenance	3-4 years	• Management of tailings produced from processing ore • Processing of ore • Environmental monitoring of groundwater • General management of waste derived from processing activities • Accidents and malfunctions to include fuel and other spills, forest fires, and a haul truck accident
Decommissioning and Reclamation	1-2 years	• Environmental monitoring of surface water discharges • Accidents and malfunctions to include fuel and other spills, forest fires, and mobile equipment accidents

6.4.6.1 Beaver Dam Mine Site and Haul Road

Groundwater and surface water at the site interact in many areas with the main control being topography. Areas of recharge are typically the higher areas and areas of discharge being in the lower areas. Evidence of groundwater discharge to the surface water systems are abundant and mainly appear in the form of seeps and wetlands. The site has features that create these abundant interactions such as high precipitation (1.4 metres per year), shallow bedrock that is relatively impermeable, permeable soil and till units and undulating topography. Effects will be short term and range from locally significant to insignificant.

The key sensitive receptor in the area of the Beaver Dam mine site is the Beaver Lake IR 17; a satellite community of the Millbrook First Nation located approximately 5 km south of the Beaver Dam mine site. The nearest domestic well is 5.5 kilometres southwest from and up-gradient of the site, at a residence along Hwy 224. Impacts to groundwater quality and quantity are not anticipated to affect Beaver Lake IR 17.

6.4.6.2 Touquoy Processing Facility

At the Touquoy facility, surface water contribution to groundwater would be very limited given the thickness, continuity, and permeability of the confining till and the relative impermeability of the bedrock.

In relation to the Touquoy mine site, Camp Kidston, which operates only in the summer months, is located 3.5 km northeast of the Touquoy facility. According to the Proponent, the nearest permanent full-time occupied residences are located approximately 5.8 km to the north of the Touquoy open pit along Caribou Road. The next closest permanent residences to the Touquoy processing and tailings management facility are approximately 7.4 km to the northwest and 11.7 km to the southeast.

The Touquoy facility is currently under construction with full operation expected in Fall 2017. Tailings produced from processing Beaver Dam ore will be disposed of in the Touquoy open pit once this is fully exhausted of ore. Seepage from the deposited tailings will be recirculated through the processing facility in a closed loop during the period of processing Beaver Dam ore at the Touquoy facility. Once the Beaver Dam ore is finished being processed and the Touquoy pit begins to refill this recirculation will cease. Make up water requirements will be sourced from Scraggy Lake or other sources as per NSE approvals. The Beaver Dam tailings will be managed in the exhausted Touquoy open pit mine. As originally planned in the approved Touquoy Gold Mine Project Reclamation Plan, the inflow of groundwater, surface flow and precipitation into the pit will naturally create a lake upon closure of the site. The primary potential effect of the continued use of the Touquoy facility on groundwater quality is the use of the exhausted open pit for tailings storage with possible seepage degrading groundwater quality, and the potential for accidents and malfunctions.

The approved Touquoy Environmental Assessment stated that the pit would be allowed to fill naturally with water over a period of time through precipitation, surface flow and groundwater in-flow. No change to this method is planned following the deposition of Beaver Dam tails, except that the time frame for refilling will be shorter given the decrease in available volume taken by the tailings. There are no predicted or potential changes associated with physical aspects of the hydrology or hydrogeology for the Site.

There are potential impacts to groundwater quality as a result of the storage of Beaver Dam tailings in the exhausted Touquoy open pit mine. These potential impacts would be minor in nature and consist of groundwater quality changes within a short radius of the flooded pit. Tailings will be subject to cyanide destruction at the process plant before flowing to the exhausted open pit. Previous works conducted during the Touquoy EARD and Focus Report identified that cyanide destruction to cyanate is proven 99.5% effective. Cyanate decomposes harmlessly. The majority of the residual cyanide reagent introduced to the tailings during ore processing will be degraded and hydrolyzed to carbon dioxide and ammonium during storage in the tailings pond. Similarly, this will be expected to occur for the Beaver Dam tailings being stored in the Touquoy open pit. Based on the results of testing conducted as part of the Feasibility Study, detoxification of the effluent will result in levels of copper and cyanide that are below the MMER limits (Ausenco 2015). Additionally, based on work conducted in 2007 for the Focus Report, the surface water contribution to groundwater is considered to be limited in this area, due to a confining till layer and impermeable bedrock.

Groundwater quantity will not be affected by the processing of the Beaver Dam ore at the Touquoy facility.

Groundwater quality and quantity will continue to be monitored over the life of the Touquoy facility as part of existing approvals and any additional approval requirements for the currently approved life span of the facility and for the proposed extended life of the Touquoy site associated with processing of Beaver Dam ore. The limited interconnection between the Pit and the surrounding groundwater and surface water regimes outlined above makes the deposition of the Beaver Dam tailings in the Touquoy a low risk activity. Groundwater quality data for the tailings management facility from the compliance program at Touquoy will be available to the AGC team. This will allow more refinement in the potential effects prediction for the Beaver Dam tailings deposition in the pit using up to 7 years of data prior to the Beaver Dam tailings being introduced to the exhausted Touquoy pit. Groundwater monitoring locations are provided on Figure 2.2-4. This is discussed further in Section 6.4.7.

6.4.7 Mitigation and Monitoring

Measures are identified in the table below along with an overview of the monitoring planned for the Beaver Dam mine site and ongoing for the Touquoy facility. Monitoring of groundwater quality and quantity ties into other VCs at the site and therefore it should be noted that the data collected from the water level and chemistry programs outlined will assist with other programs as well as the EEM aspects for this and other VCs such as wetlands and surface water.

Mitigation measures will generally focus on sediment and erosion control and minimizing the use of groundwater as a water resource. A groundwater monitoring program will be undertaken throughout the life of the Project and is outlined below. An annual review of the surface water, groundwater, and wetlands monitoring programs will be undertaken to determine potential interactions between these VCs. Revisions to the program will be completed as required.

The frequency and location of groundwater monitoring will be described in greater detail in the EPP following consultation with regulatory agencies and will be outlined in the IA application. It is anticipated that water levels will be collected monthly and chemistry samples will be collected quarterly throughout pre-construction, construction, operations). The decommissioning phase will likely start out with the same frequency, locations and parameters and, if the data supports this, a reduction in monitoring may occur until such time that Atlantic Gold is released from monitoring requirements.

The Touquoy facility is currently under construction. Mitigation measures will be applied to reduce the potential environmental impacts of the Project on groundwater at the Touquoy facility as per existing approvals. The placement of Beaver Dam tailings in the exhausted Touquoy open pit mine will occur over the course of approximately four years. Throughout this time, the pit will be slowly filling with water and ongoing groundwater monitoring will be occurring in the area of the open pit throughout the entire process. The existing IA for the Touquoy facility includes the following elements:

- Thirty-two (32) groundwater monitoring stations established in and around the facility; these are each nested well pairs with a shallow and deep well;
- Water levels in each well are measured monthly and water is sampled for chemical analysis each quarter for prescribed parameters, including metals, nutrients and other general water chemistry parameters;
- Around the open pit mine, data loggers are in place in seven wells, which record water levels in the wells on an hourly basis at a minimum;
- Ongoing review of monitoring data, which is compared with the approach as prescribed in the Groundwater Contingency Plan. This includes a comparison of data with baseline levels and accepted water quality guidelines, such as CCME Water Quality Guidelines for the Protection of Aquatic Life; and
- Records of water level, groundwater quality, and any corrective actions are to be submitted to NSE in the annual report for the Touquoy facility; however, any non-compliance is identified to NSE in timely fashion as per the IA.

It is anticipated that the future IA for Beaver Dam Mine Project will have similar requirements for mitigation and monitoring related to potential environmental effects of the Project activities. The collection of this data prior to operational activities relative to the Beaver Dam Mine Project provides additional baseline data (that support the anticipated mitigation measures and follow up and monitoring programs. These groundwater monitoring locations are provided on Figure 2.2-4.

There is also a Groundwater Contingency Plan in place for the Touquoy Tailings Management Facility. It is anticipated that elements of this Plan will be applicable to the deposition of Beaver Dam tailings in the exhausted open pit.

Table 6.4-7 Mitigation and Monitoring Program for Groundwater Quality and Quantity

Project Activity	Mitigation Measures	Monitoring Program
Site Preparation and Construction	Sediment and erosion control	• Installation of far network of multi-depth (shallow till and shallow bedrock) monitor wells (6-8 anticipated to be proposed) outside disturbed footprint approximately one year prior to the beginning of the construction phase. Water level and chemistry monitoring program to be proposed, and are anticipated to include monthly water levels and quarterly chemistry samples for the duration of the pre-construction, construction, and operation phases. • An annual review of the monitoring program will be undertaken to determine the need for revisions based on baseline data comparison and discussions with regulators.

Table 6.4-7 Mitigation and Monitoring Program for Groundwater Quality and Quantity

Project Activity	Mitigation Measures	Monitoring Program
Operation and Maintenance – Beaver Dam	Sediment and erosion control Project design to use pit dewatering water and collected surface water instead of groundwater	• Installation of near network multi-depth (shallow till and shallow bedrock) monitor wells (6-8 anticipated to be proposed) close to and within disturbed footprint at the beginning of operations. Water level and chemistry monitoring program to be proposed, and are anticipated to include monthly water levels and quarterly chemistry samples for the duration of the operation phase. • An annual review of the monitoring program will be undertaken to determine the need for revisions based on baseline data comparison and discussions with regulators.
Operation and Maintenance – Touquoy	Sediment and erosion control	• Ongoing monitoring as per regulatory requirements, which began in 2016. This includes ongoing monitoring of 32 nested groundwater monitoring wells. Seven of the monitoring wells located around the open pit also have data loggers in place, which record hourly water levels. This program will be reviewed by regulators and any appropriate changes to the monitoring program due to the processing of Beaver Dam ore will be implemented. • An annual review of the monitoring program will be undertaken to determine the need for revisions based on baseline data comparison and discussions with regulators.
Decommissioning and Reclamation	Sediment and erosion control – no water use except for dust control anticipated	• Select far and near network wells to be proposed for this phase based on results of mine life monitoring program. 6-8 anticipated to be proposed for water level and chemistry monitoring. Monitoring will be conducted at the same locations, frequency and for the same parameters until such time that the data suggests that a reduction can occur during the decommissioning and reclamation phase of the Project. • An annual review of the monitoring program will be undertaken to determine the need for revisions based on baseline data comparison and discussions with regulators.

6.4.8 Residual Effects and Significance

The predicted residual environmental effects of Project development and production on groundwater are assessed to be adverse, but not significant. The overall residual effect of the Project on groundwater is assessed as not significant after mitigation measures have been implemented. Effects to groundwater supplies used for domestic purposes are not anticipated due to distance from site activities. The reclamation plan for the site includes a refilling of the pit to mimic the current conditions at the site so that post-mining conditions are not significantly different than baseline conditions.

There is the potential for residual groundwater quality issues related to the storage of tailings in the expended pit at the Touquoy facility. The overall residual effects of the Project on groundwater at Touquoy are assessed as not significant after mitigation measures have been implemented.

Table 6.4-8 Residual Environmental Effects for Groundwater

Project - VC Interactions	Nature of Effect	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
Clearing and grubbing (reduced infiltration)	A	Sediment and erosion control, reclamation during decommissioning and best management practices. Installation of multi-depth monitoring wells. Water level and chemistry monitoring program to be proposed.	M	PA	LT	R	R	MD	Disturbance	Not Significant
Heavy machinery operation (impacts to sediments, accidents and contamination)	A	Sediment and erosion control, spill preparedness and best management practices	M	PA	ST	R	R	LD	Disturbance	Not Significant
Potable wells at Beaver Lake IR 17 (water quality as a result of Project activities)	-	N/A	-	-	-	-	-	-	None	N/A
Direct surface waterbody alteration (dewatering, infilling, draining, flooding, altering function, altering groundwater recharge capacity)	A	Engage watercourse alteration permitting process Installation of multi-depth monitor wells. Water level and chemistry monitoring program to be proposed.	M	PA	P	O	IR	LD	Disturbance	Not Significant

Table 6.4-8 Residual Environmental Effects for Groundwater

Project - VC Interactions	Nature of Effect	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
		Project design includes use of pit dewatering water and collected surface water instead of groundwater for dust control. No other on-site water use except for small domestic purposes (office building less than 10 Lpm) expected.								
In-direct surface waterbody alteration (water quality, hydrological imbalance, sedimentation)	A	Installation of multi-depth monitor wells. Water level and chemistry monitoring program to be proposed. Project design includes use of pit dewatering water and collected surface water instead of groundwater for dust control. No other on-site water use except for small domestic purposes (office building less than 10 Lpm) expected.	L	PA	MT	S	R	LD	Disturbance	Not Significant
Widening and new haul road construction and	A	Engage watercourse alteration permitting process	L	PA	P	O	IR	LD	Disturbance	Not Significant

Table 6.4-8 Residual Environmental Effects for Groundwater

Project - VC Interactions	Nature of Effect	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
maintenance (hydrological changes, surface water body alteration and sediments)		Surface water monitoring								
Storage of tailings in the expended pit at the Touquoy facility (groundwater quality)	A	Best management practices Continuation of the monitoring program that is currently underway at Touquoy (since 2016).	L	PA	P	R	IR	MD	Disturbance	Not Significant

Legend (refer to Table 5.10-1 for definitions)

Nature of Effect	Geographic Extent	Frequency	Ecological and Social Context
A Adverse	PA Project Area	O Once	LD Low Disturbance
P Positive	LAA Local Assessment Area	S Sporadic	MD Moderate Disturbance
	RAA Regional Assessment Area	R Regular	HD High Disturbance
Magnitude		C Continuous	
N Negligible	**Duration**	**Reversibility**	
L Low	ST Short-Term	R Reversible	
M Moderate	MT Medium-Term	IR Irreversible	
H High	LT Long-Term		
	P Permanent		

6.4.9 Proposed Compliance and Effects Monitoring Program

As the Project moves forward, monitoring programs will proceed to gather pre-construction groundwater baseline data. Monitoring programs will continue during construction, operation, and post-production to verify baseline conditions and to determine the effects of the Project on groundwater in the PA. Table 6.4-7 summarizes the mitigation and monitoring activities that will be completed throughout the life of the Project. A groundwater monitoring program will be developed in association with requirements of wetland and watercourse alteration permits issued for direct wetland and watercourse alterations associated with the Project.

The details of the monitoring programs will be determined in consultation with regulatory agencies and will be described in the application for an IA for the site operations following the EA process. High level detail is needed in this application and would be subject to review by NSE and other agencies. An EMS and EPP will be developed as part of the Project implementation that will confirm the responsibility and system of accountability for the compliance and effects monitoring program.

Any program developed will be specific in terms of goals to outline temporal, quality and quantity changes so that a determination can be made on changes from baseline and if these are an issue for the groundwater VC or connected surface water and wetland VCs.

The objectives of the groundwater monitoring programs are to:

- Verify effects predicted in the EIS;
- Confirm the continuing effectiveness of mitigation measures;
- Identify the need for any new mitigation measures; and
- Confirm compliance with regulatory approvals and requirements.

Groundwater monitoring programs will include the following, as well as additional monitoring as determined through discussions with regulatory agencies:

- Continued monitoring of the groundwater monitoring well network currently in place at the Touquoy facility;
- Groundwater monitoring of a network of shallow till and shallow bedrock monitor wells outside of the disturbed mine footprint during the construction phase;
- Groundwater monitoring of a network of shallow till and shallow bedrock monitor wells within and near the disturbed footprint during the operations phase; and
- Groundwater monitoring of select monitor wells based on the results of the mine life monitoring program.

The frequency and location of groundwater monitoring will be described in greater detail in the EPP following consultation with regulatory agencies and will be outlined in the IA application.

6.5 Wetlands

6.5.1 Rationale for Valued Component Selection

Wetlands were selected as a valued component due to their ecological value in providing habitat for aquatic species and rare plants, the importance of wetlands in the daily lives of terrestrial species, their capacity to store water, managing downstream flooding, improving water quality, and the recharge/discharge of groundwater aquifers. The socio-economic importance of wetlands from a recreational and resource perspective is also noted in the selection of wetlands as a valued component (Section 6.1.4 of the EIS Guidelines and its potential interactions with Project activities).

6.5.2 Baseline Program Methodology

A desktop review of available topographic maps, provincial databases, and aerial photography was completed to aid in the determination of wetland habitat in the PA. Mapped wetland areas were identified from the NSDNR Wetland Inventory Database, the Nova Scotia Topographic Database, and the Nova Scotia Wet Areas Mapping (WAM) database. The Wetland of Special Significance (WSS) GIS predictive layer provided by NSE was consulted for the presence of WSS within the PA.

Field surveys were completed within the PA from June to August 2015 (mine footprint) and June to July 2016 (Haul Road), following the initial desktop review. Targeted surveys were completed within the PA where mapped systems were present to confirm and delineate wetland habitat. Meandering transects were also completed across the PA to support efforts to delineate all wetlands present within the PA, beyond those identified in the available database resources. Trained wetland delineators and evaluators completed all field surveys. Isolated wetlands that were obviously identified as <100 m^2 in the field were not delineated due to the minimum size requirement of a provincially regulated wetland. However, if a wetland was near 100 m^2, or if the delineators were unsure of the size in the field, the wetland was delineated. Wetlands determined to be smaller than 100 m^2 post field evaluation were not included on figures nor were these small wetland areas considered for the effects assessment.

Delineated wetlands that extended outside of the PA (for both the mine footprint and the Haul Road footprint) were only delineated to the PA boundary. Wetland habitat extending beyond the PA was evaluated through desktop resources, including topographic mapping, NSDNR wetland inventory, and the WAM to estimate wetland type, size, and broad wetland function.

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

Wetland boundaries were documented using an SXBlue II Global Positioning System (GPS) receiver unit capable of sub-metre accuracy with a handheld SXPad field computer. Any inlet and outlet streams or other features associated with each wetland present within the PA were marked during the delineation processes, as well as walked and mapped. Pink flagging tape was used to mark the boundaries of wetlands and blue flagging tape was used to mark the locations of associated watercourses.

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

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

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

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

If the majority (greater than 50%) of the dominant vegetation at a data point is classified as obligate (OBL), facultative wetland (FACW), or facultative (FAC) (excluding FAC-), then the location of the data point is considered to be dominated by hydrophytic vegetation.

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

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

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

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

6.5.2.1 Wetland Functional Assessment

Observations were made on wetland types, water flow path, dominant vegetation communities (and SAR/SOCI, if present), fish habitat potential and characterization, and wetland function. The analysis of wetland function was completed for each wetland using the NSE NovaWET 3.0 wetland evaluation technique. The evaluation of wetland function included gathering field and desktop information to support conclusions relating to wetland characteristics, condition and integrity of adjacent lands, identification of exceptional features, hydrologic condition and integrity, water quality, groundwater interactions, shoreline stabilization, plant community, fish and wildlife habitat and habitat integrity, and community use and value.

Results of the NovaWET functional assessment are provided in Section 6.5.3.1. In addition, summaries specific to the Guidelines for Preparation of an Environmental Impact Statement, Beaver Dam Mine, January 2016 (p. 23) are also provided herein.

6.5.3 Baseline Conditions

Sixty-three wetlands were identified within the mine footprint and 116 wetlands were identified along the Haul Road footprint for a total of 179 freshwater wetlands. The wetland types, approximate sizes within the PA, and tertiary watershed locations are described in Table 6.5-1, and indicated on Figure 6.3-3 and Figures 6.3-3A to 6.3.3L.

Table 6.5-1 Wetland Types and Approximate Sizes

Wetland	Wetland Type	Wetland Area* (m2)	Footprint	Tertiary Watershed
1	complex: mixed wood treed bog, tall shrub bog, open low shrub bog	37,188	Mine	Tent Lake and Kent Lake
2	complex: coniferous treed bog, graminoid bog, low shrub bog, shrub bog	196,857	Mine	Tent Lake, Kent Lake, and Cameron Flowage
3	shrub bog	4,658	Mine	Cameron Flowage
4	complex: treed swamp/ treed fen, mixed wood treed swamp	13,139	Mine	Cameron Flowage
5	mixed wood treed swamp	6,202	Mine	Cameron Flowage
6	mixed wood treed swamp	262	Mine	Cameron Flowage
7	cut treed swamp	306	Mine	Cameron Flowage
8	complex: coniferous treed swamp, graminoid fen, low shrub fen, shrub swamp	16,603	Mine	Cameron Flowage

Table 6.5-1 Wetland Types and Approximate Sizes

Wetland	Wetland Type	Wetland Area* (m2)	Footprint	Tertiary Watershed
9	open bog	307	Mine	Kent Lake
10*	low shrub fen	7,359	Mine	Cameron Flowage
11	complex: low shrub bog, mixed wood treed swamp	2,955	Mine	Cameron Flowage
12	complex: open mixed wood treed swamp, coniferous treed swamp	4,475	Mine	Cameron Flowage
13	complex: treed swamp, coniferous treed swamp	4,816	Mine	Cameron Flowage
14*	complex: shrub bog, mixed wood treed swamp, low shrub fen	21,528	Mine	Cameron Flowage
15	graminoid fen	406	Mine	Cameron Flowage
16*	open shrub swamp	1,321	Mine	Cameron Flowage
17*	complex: tall shrub swamp, coniferous treed bog	72,737	Mine	Cameron Flowage
18	coniferous treed swamp	1,864	Mine	Cameron Flowage
19	shrub bog	11,428	Mine	Cameron Flowage
20	mixed wood treed fen	10,106	Mine	Cameron Flowage
21	mixed wood treed swamp	202	Mine	Kent Lake
22	mixed wood treed swamp	274	Mine	Kent Lake
23	coniferous treed swamp	419	Mine	Kent Lake
24	coniferous treed swamp	328	Mine	Kent Lake
25	coniferous treed swamp	1,416	Mine	Kent Lake
26	coniferous treed swamp	658	Mine	Kent Lake
27	mixed wood treed swamp	493	Mine	Kent Lake
28	coniferous treed swamp	222	Mine	Kent Lake
29*	complex: mixed wood treed swamp, low shrub fen, open bog, coniferous treed swamp, coniferous raised bog, graminoid fen	116,021	Mine	Kent Lake and Cameron Flowage
30	coniferous treed swamp	964	Mine	Kent Lake

Table 6.5-1 Wetland Types and Approximate Sizes

Wetland	Wetland Type	Wetland Area* (m2)	Footprint	Tertiary Watershed
31*	coniferous treed swamp	6,520	Mine	Kent Lake and Cameron Flowage
32	coniferous treed swamp	120	Mine	Kent Lake
33	coniferous treed swamp	1,900	Mine	Kent Lake
34	mixed wood treed swamp	1,382	Mine	Cameron Flowage
35	coniferous treed swamp	3,376	Mine	Kent Lake and Cameron Flowage
36	coniferous treed swamp	916	Mine	Kent Lake
37	deciduous treed swamp	253	Mine	Kent Lake
38	coniferous treed swamp	388	Mine	Kent Lake and Cameron Flowage
39	coniferous treed swamp	1,857	Mine	Cameron Flowage
40	coniferous treed swamp	8,091	Mine	Cameron Flowage
41	graminoid marsh	910	Mine	Cameron Flowage
42	coniferous treed swamp	1,879	Mine	Cameron Flowage
43	mixed wood treed swamp	81	Mine	Cameron Flowage
44	coniferous treed bog	10,611	Mine	Cameron Flowage
45	coniferous treed swamp	295	Mine	Cameron Flowage
46	coniferous treed riverine swamp	754	Mine	Cameron Flowage
47	fresh water marsh	1,029	Mine	Cameron Flowage
48	coniferous treed swamp	2,876	Mine	Cameron Flowage
49	coniferous treed swamp	117	Mine	Cameron Flowage
50	coniferous tall shrub swamp	117	Mine	Cameron Flowage
51	mixed wood treed swamp	898	Mine	Cameron Flowage

Table 6.5-1 Wetland Types and Approximate Sizes

Wetland	Wetland Type	Wetland Area* (m2)	Footprint	Tertiary Watershed
52	coniferous treed swamp	1,620	Mine	Cameron Flowage
53	low shrub swamp	824	Mine	Cameron Flowage
54	coniferous treed bog	416	Mine	Kent Lake
55	mixed wood treed swamp	616	Mine	Cameron Flowage
56	complex: coniferous treed swamp, tall shrub swamp, low shrub bog	16,275	Mine	Cameron Flowage
57*	complex: coniferous treed swamp, deciduous treed swamp	88,769	Mine	Tent Lake and Cameron Flowage
58	deciduous treed swamp	581	Mine	Cameron Flowage
59	coniferous treed swamp	65,348	Mine	Cameron Flowage
60	coniferous treed swamp	2,963	Mine	Cameron Flowage
61*	complex: deciduous treed swamp, tall shrub swamp, open low shrub fen	24,653	Mine	Cameron Flowage
62	coniferous treed swamp	832	Mine	Cameron Flowage
63	coniferous treed swamp	492	Mine	Kent Lake
Total Delineated Wetland Habitat within Mine Footprint: 783,272 m2 (78.33 ha)				
64*	complex: low shrub bog, mixed wood treed swamp	15,979	Haul Road	Tent Lake
65	open bog	65	Haul Road	Tent Lake
66*	complex: graminoid fen, mixed wood treed swamp, high shrub fen	15,423	Haul Road	Tent Lake
67*	complex: low shrub fen, tall shrub fen	1,433	Haul Road	Tent Lake
68*	complex: shrub fen, graminoid fen and mixed wood treed swamp	5,579	Haul Road	Tent Lake
69*	complex: shrub fen, graminoid fen, and mixed wood treed swamp	3,899	Haul Road	Tent Lake
70*	tall shrub swamp	631	Haul Road	Tent Lake

Table 6.5-1 Wetland Types and Approximate Sizes

Wetland	Wetland Type	Wetland Area* (m2)	Footprint	Tertiary Watershed
71	deciduous treed swamp	425	Haul Road	Brandon Lake
72	deciduous treed swamp	1,471	Haul Road	Brandon Lake
73*	complex: tall shrub swamp, tall shrub fen	26,893	Haul Road	Brandon Lake
74*	complex: mixed wood treed swamp, fresh water marsh	12,340	Haul Road	Brandon Lake
75	mixed wood treed swamp	144	Haul Road	Brandon Lake
76*	complex: mixed wood treed swamp, open graminoid fen	10,405	Haul Road	Brandon Lake
77*	mixed wood treed swamp	1,204	Haul Road	Brandon Lake
78	mixed wood treed swamp	194	Haul Road	Brandon Lake
79*	coniferous treed swamp	3,703	Haul Road	Brandon Lake
80*	coniferous bog	979	Haul Road	Brandon Lake
81	tall shrub swamp	154	Haul Road	Brandon Lake
82*	mixed wood treed swamp	616	Haul Road	Brandon Lake
83*	mixed wood treed swamp	535	Haul Road	Brandon Lake
84*	low shrub swamp	695	Haul Road	Brandon Lake
85*	low shrub swamp	322	Haul Road	Brandon Lake
86*	mixed wood swamp	4,684	Haul Road	Brandon Lake
87*	open bog	362	Haul Road	Brandon Lake
88	tall shrub swamp	417	Haul Road	Brandon Lake
89*	treed swamp	6,194	Haul Road	Brandon Lake
90*	mixed wood treed swamp	4,495	Haul Road	Brandon Lake
91*	mixed wood treed swamp	1,060	Haul Road	Brandon Lake

Table 6.5-1 Wetland Types and Approximate Sizes

Wetland	Wetland Type	Wetland Area* (m2)	Footprint	Tertiary Watershed
92*	mixed wood treed swamp	1,943	Haul Road	Brandon Lake
93	graminoid marsh	166	Haul Road	Brandon Lake
94*	mixed wood treed swamp	1,748	Haul Road	Brandon Lake
95*	mixed wood treed swamp	263	Haul Road	Brandon Lake
96*	mixed wood treed swamp	861	Haul Road	Brandon Lake
97	mixed wood treed swamp	107	Haul Road	Brandon Lake
98*	mixed wood treed swamp	1,540	Haul Road	Rocky Brook Lake
99*	mixed wood treed swamp	694	Haul Road	Rocky Brook Lake
100	shrub swamp	1,582	Haul Road	Rocky Brook Lake
101	clear cut swamp	219	Haul Road	Rocky Brook Lake
102	complex; mixed wood treed bog, mixed wood treed swamp	5,439	Haul Road	Rocky Brook Lake
103	low shrub bog	455	Haul Road	Rocky Brook Lake
104	low shrub swamp	102	Haul Road	Rocky Brook Lake
105	low shrub bog	284	Haul Road	Rocky Brook Lake
106*	low shrub bog	1,701	Haul Road	Rocky Brook Lake
107	coniferous treed swamp	186	Haul Road	Lake Alma
108	tall shrub swamp	183	Haul Road	Lake Alma
109	coniferous treed swamp	1,606	Haul Road	Lake Alma and Rocky Brook Lake
110*	shrub bog	912	Haul Road	Lake Alma
111*	mixed wood swamp	1,060	Haul Road	Lake Alma
112*	mixed wood swamp	3,595	Haul Road	Lake Alma
113*	mixed wood treed swamp	1,940	Haul Road	Lake Alma
114	coniferous swamp	242	Haul Road	Lake Alma
115*	mixed wood treed swamp	582	Haul Road	Lake Alma

Table 6.5-1 Wetland Types and Approximate Sizes

Wetland	Wetland Type	Wetland Area* (m2)	Footprint	Tertiary Watershed
116	coniferous swamp	892	Haul Road	Lake Alma
117	coniferous swamp	147	Haul Road	Lake Alma
118	coniferous swamp	428	Haul Road	Lake Alma
119	coniferous treed swamp	328	Haul Road	Lake Alma
120	low shrub swamp	115	Haul Road	Lake Alma
121	coniferous swamp	154	Haul Road	Lake Alma
122	coniferous treed swamp	200	Haul Road	Lake Alma
123	mixed wood treed swamp	818	Haul Road	Lake Alma
124*	mixed wood treed swamp	528	Haul Road	Lake Alma
125	mixed wood treed swamp	344	Haul Road	Lake Alma
126	mixed wood treed swamp	63	Haul Road	Lake Alma
127*	treed bog	185	Haul Road	Lake Alma
128	tall shrub bog	409	Haul Road	Lake Alma
129	treed bog	2,006	Haul Road	Lake Alma
130	coniferous treed swamp	1,092	Haul Road	Middle Beaver Lake and Lake Alma
131	mixed wood treed swamp	1,087	Haul Road	Middle Beaver Lake
132	mixed wood treed swamp	2,425	Haul Road	Lake Alma
133	low shrub bog	102	Haul Road	Lake Alma
134	treed swamp	398	Haul Road	Lake Alma
135*	shrub fen	934	Haul Road	Lake Alma
136	mixed wood treed swamp	522	Haul Road	Lake Alma
137*	mixed wood treed swamp	2,404	Haul Road	Lake Alma
138	shrub bog	1,521	Haul Road	Lake Alma
139	tall shrub bog	106	Haul Road	Lake Alma
140	treed bog	230	Haul Road	Lake Alma
141	high shrub bog	60	Haul Road	Lake Alma
142	low shrub bog	342	Haul Road	Lake Alma
143	complex: graminoid bog, deciduous treed swamp	526	Haul Road	Lake Alma
144*	tall shrub fen	2,034	Haul Road	Lake Alma
145*	low shrub bog	1,462	Haul Road	Lake Alma

Table 6.5-1 Wetland Types and Approximate Sizes

Wetland	Wetland Type	Wetland Area* (m2)	Footprint	Tertiary Watershed
146*	complex: graminoid fen, mixed wood treed swamp	2,653	Haul Road	Lake Alma
147*	complex: low shrub bog, mixed wood treed swamp	2,708	Haul Road	Lake Alma
148*	low shrub bog	9,220	Haul Road	Lake Alma
149*	low shrub bog	1,811	Haul Road	Lake Alma
150	marsh	145	Haul Road	Lake Alma
151*	tall shrub bog	2,959	Haul Road	Lake Alma
152*	clear cut mixed wood swamp	2,046	Haul Road	Lake Alma
153*	shrub swamp	2,416	Haul Road	Lake Alma
154*	open bog	1,991	Haul Road	Lake Alma
155*	mixed wood treed swamp	717	Haul Road	Lake Alma
156*	shrub bog	14,756	Haul Road	Lake Alma and Eagles Nest Basin
157*	complex: shrub fen, shrub swamp	7,006	Haul Road	Lake Alma and Eagles Nest Basin
158	shrub swamp	575	Haul Road	Eagles Nest Basin
159*	mixed wood treed swamp	1,995	Haul Road	Eagles Nest Basin
160*	freshwater marsh	1,237	Haul Road	Eagles Nest Basin
161	mixed wood swamp	1,618	Haul Road	Eagles Nest Basin
162*	mixed wood treed swamp	1,756	Haul Road	Eagles Nest Basin
163*	clear-cut swamp	1,107	Haul Road	Eagles Nest Basin
164*	mixed wood treed swamp	3,320	Haul Road	Eagles Nest Basin
165*	mixed wood treed swamp	1,623	Haul Road	Eagles Nest Basin
166	shrub swamp	68	Haul Road	Eagles Nest Basin
167*	mixed wood treed swamp	875	Haul Road	Eagles Nest Basin
168*	open bog	664	Haul Road	Eagles Nest Basin

Table 6.5-1 Wetland Types and Approximate Sizes

Wetland	Wetland Type	Wetland Area* (m2)	Footprint	Tertiary Watershed
169*	mixed wood treed swamp	607	Haul Road	Eagles Nest Basin
170*	mixed wood treed swamp	1,893	Haul Road	Eagles Nest Basin
171*	mixed wood treed swamp	4,329	Haul Road	Rocky Lake
172	mixed wood treed swamp	229	Haul Road	Rocky Lake
173*	mixed wood treed swamp	4,814	Haul Road	Rocky Lake
174*	mixed wood treed swamp	2,513	Haul Road	Rocky Lake
175*	shrub swamp	611	Haul Road	Rocky Lake
176*	mixed wood treed swamp	446	Haul Road	Rocky Lake
177*	shrub swamp	755	Haul Road	Rocky Lake
178*	mixed wood treed swamp	4,439	Haul Road	Rocky Lake
179*	mixed wood treed swamp	3,412	Haul Road	Rocky Lake
Total Delineated Wetland Habitat within Haul Road: 256,887 m2 (25.69 ha)				
Total Delineated Wetland Habitat within PA: 104.01 ha				

**Wetland area is calculated based on field delineation within the Project Area.*
*Wetland # marked with an * extend beyond the Project Area boundaries, and total size has not been calculated.*

In general, hydrological flow within wetlands present in the mine footprint PA initiates at the southern extent of the PA, at the division of three tertiary watershed boundaries (see watershed characteristics in Section 6.5.3.1). Larger wetland complexes straddle the watershed boundaries (notably wetlands 1, 2, 29, 32, and 57) and act as the primary outflow water source for downgradient wetlands, watercourses, and lower lying lakes. Wetlands 1 and 2 exist as bog complexes, which intercept and store precipitation and small scale water seepage from surrounding land prior to draining via additional aquatic features to the north and south. As is typical of these habitats in Nova Scotia, bog formations located on higher land have the ability to source water to more than one tertiary watershed. In this case, water predominantly flows northward into the Cameron Flowage tertiary watershed, although water is also drained southward, notably from wetland 2 into wetland 1 and the Tent Lake tertiary watershed. The same can be said for wetlands 29 and 57, which also exist as complexes (albeit with a larger swamp component), but outflow northward toward Crusher Lake and Cameron Flowage and southward into Kent Lake and Tent Lake tertiary watersheds, respectively.

As water drains northward through the mine footprint PA, it does so via predominantly swamp habitat, often associated with watercourses or small-scale surface channelization (i.e., throughflow in nature). While intermixed with a scattering of isolated wetlands, swamps dominate the central portions the Cameron Flowage tertiary watershed and act as either mechanisms to drain water northward from the larger wetland complexes in the south, or in the case of isolated wetlands, form in small topographically defined basin formations. The major receptors of water within the mine PA are initially Crusher Lake, with Mud Lake and Cameron Flowage ultimately receiving most water from within the PA prior to it draining offsite to the southeast. Larger riparian swamp wetlands (e.g., wetland 17 and wetland 61) border Mud Lake and Cameron Flowage, intercepting water prior to releasing it into the water bodies.

A lesser quantity of water exists within wetlands located in the headwaters of the Kent Lake watershed, whereby wetland 29 appears to be the major outflow of water. The remaining wetlands identified in this watershed are isolated in nature and provide groundwater recharge capacities rather than act as a source of surface water discharge to lower lying features.

Due to its extensive length and intersection with seven separate tertiary watersheds, wetlands along the Haul Road PA vary between outflow wetlands located at headwater locations, throughflow wetlands that drain water toward lower reaches of the watersheds, and some instances of wetlands within lower portions of the watershed. As is typical of the Nova Scotia landscape, however, smaller isolated wetlands were also identified in all regions of all watersheds.

6.5.3.1 Functional Assessment Results

The NovaWET functional evaluation technique consists of 11 major sections associated with key wetland functions as listed below:

- Watershed Characteristics;
- Wetland Characterization;
- Condition and Integrity of Adjacent Land;
- Identification of Exceptional Features;
- Hydrologic Condition and Integrity;
- Water Quality;
- Groundwater Interactions;
- Shoreline Stabilization and Integrity;
- Plant Community;
- Fish and Wildlife Habitat and Integrity; and
- Community Use/Value

Each section contains questions specific to a function that supports the assessor in determining to what degree the wetland provides significant functions (SF). NovaWET continues to identify critical (SF red flag functions highlighted red) wetland functions that are often unique or rare or associated with higher risk to the watershed if lost. The Wetland Functional Assessment Summary Table included in **Appendix F** provides the results of the SF determination for all wetlands within the mine site and Haul Road PAs.

Additional details for each wetland, including functional summary sheets, plant lists, photographs, and data sheets were recorded by MEL staff during field evaluations, but have not been included in this document due to the volume of data (179 wetlands within the PA). These data are available upon request.

The following sections provide results of the NovaWET functional assessment.

Watershed Characteristics

The functional assessments conducted for the 179 wetlands located within the PA determined that the overall watershed condition of the nine relevant tertiary watersheds is in a relatively unaltered state (Table 6.5-2). Urban/commercial development is not present within the watersheds and, therefore, existing roads account for the impervious surfaces calculated within the watershed evaluation, resulting in a range of 0% to 0.62%, with the higher percentages being along the existing Haul Road. Therefore, condition is classified as low. Wetland habitat cover ranges from 3.40% to 22.19% of the total land area of the watersheds. Four of the watersheds provide a high ability to contribute to floodwater protection (<10% wetland cover), all of which comprise the future Haul Road footprint. Moderate floodwater protection (10 to 20% wetland cover) is afforded by four watersheds (of which two comprise the future mine footprint and two comprise the Haul Road footprint), and one watershed provides low floodwater protection (>20% wetland cover) and comprises the Haul Road footprint.

Most buffer areas surrounding the wetlands are highly vegetated. These wetlands and buffers generally offer high quality wildlife habitat and good water quality functions. Forestry activity was documented in habitat along the Haul Road and is also present surrounding the mine footprint PA. All wetlands assessed were determined to provide high plant community integrity as the plants are generally composed of native species characteristic of the wetland type with a minor component of non-native species.

Table 6.5-2 Detailed Watershed Evaluation Results

Tertiary Watershed	Watershed #	Location in Project Area	Describe Watershed Condition (% impervious surface)	% wetland cover	Total WS Area (ha)	Total (WL) area ha	Road Surface length (m)	Road area ha (@6.5 m wide)
Cameron Flowage	1EM-2D	Mine	0.00	12.52	6727.78	842.11	0	0
Kent Lake	1EM-2H	Mine	0.00	22.19	871.12	193.31	0	0
Tent Lake	1EM-2F	Mine/Haul Road	0.00	16.43	1086.9	178.53	0	0
Brandon Lake	1EM-2G	Haul Road	0.00	6.22	1214.2	75.55	0	0
Rocky Brook Lake	1EM-2N	Haul Road	0.62	3.40	1416.73	48.1	13434	8.7321
Lake Alma	1EM-2P	Haul Road	0.00	7.27	5041.43	366.35	363	0.23595
Middle Beaver Lake	1EM-2M	Haul Road	0.19	4.30	671.57	28.86	2014	1.3091
Eagle's Nest Basin	1EL-2C	Haul Road	0.04	10.57	5117.9	540.81	3317	2.15605
Rocky Lake	1EL-2H	Haul Road	0.00	16.84	3111.17	523.95	0	0

Wetland Characteristics

The majority (63%) of wetlands identified within the mine footprint PA were classified as swamps. Similarly, the majority of wetlands identified along the Haul Road were also classified as swamp habitat (65%). There were several wetland complexes within the PA comprised of some combination of shrub and treed bog and swamp and fen habitat. Many of these extended beyond the PA boundaries. Table 6.5-3 outlines the wetland types identified throughout the PA.

Table 6.5-3 Wetland Types within the PA

Project Area (PA)	Mine Site	Haul Road
Wetland Complex		
Number of Wetlands	13	13
% of total wetlands identified within each representative PA	21%	11%
Treed or Shrub Swamps		
# of Wetlands	40	75
% of total wetlands identified within each representative PA	63%	65%
Bog		
# of Wetlands	5	23
% of total wetlands identified within each representative PA	8%	20%
Fen		
# of Wetlands	3	2
% of total wetlands identified within each representative PA	5%	2%
Marsh		
# of Wetlands	2	3
% of total wetlands identified within each representative PA	3%	3%

The average size of the wetlands within the mine footprint is just over 1 ha. The wetlands identified in southern portions of the mine footprint PA are in headwater positions, as they are situated at the boundary of three tertiary watersheds within the West River Sheet Harbour Secondary Watershed, and many wetlands are sources of surface water for first order stream formation within their respective watersheds. Wetlands within the northern half of the mine footprint PA, however, are located in central portions of the tertiary watershed and, therefore, likely act as throughflow features.

The majority of wetlands identified along the haul road were also classified as swamps (approximately 65%). The vast majority of wetland habitat identified within the haul road PA was partially delineated, with wetland habitat extending beyond the PA boundaries. Wetlands within the haul road PA straddle seven tertiary watersheds and range from wetlands in headwater positions to wetlands near, or at the bottom of watersheds.

Detailed biophysical wetland information for each delineated wetland including wetland type, dominant vegetation, soil and hydrological conditions is provided in a Wetland Characterization Table in **Appendix G**.

Table 6.5-4 provides selected functional wetland information utilized as part of the functional assessment analysis throughout this chapter.

Table 6.5-4 Wetland Functional Information

Wetland ID	Wetland Type	Wetland Size (m2)	Landscape Position	Landform	Water Flow Path	Water Regime	Watercourse Association	Standing Water and % cover in wetland	Adjacent Upland Land Use	Stressors	Wetland Hydrology Altered?
Mine Footprint											
1	complex: Mixed wood treed bog, tall shrub bog, open low shrub bog	37,188	Terrene	Basin	Outflow-Headwater	Permanently saturated	No	<5%	Forested	None	No
2	complex: Coniferous treed bog, graminoid bog, low shrub bog, shrub bog	196,857	Terrene	Basin	Outflow-Headwater	Permanently saturated	Stream	0%	Forested	None	No
3	shrub bog	4,658	Terrene	Basin	Isolated	Permanently Saturated	No	50%	Forested	None	No
4	complex: Treed swamp/ treed fen, mixed wood treed swamp	13,139	Terrene	Basin	Throughflow	Permanently Saturated, Seasonally Flooded	Stream	20%	Forested	None	No

Table 6.5-4 Wetland Functional Information

Wetland ID	Wetland Type	Wetland Size (m2)	Landscape Position	Landform	Water Flow Path	Water Regime	Watercourse Association	Standing Water and % cover in wetland	Adjacent Upland Land Use	Stressors	Wetland Hydrology Altered?
5	mixed wood treed swamp	6,202	Terrene	Basin	Outflow-Headwater	Permanently saturated	No	5%	Forested	None	No
6	mixed wood treed swamp	262	Terrene	Basin	Isolated	Seasonally saturated	No	0%	Forested	ATV trails	Old skidder tracks
7	cut treed swamp	306	Terrene	Basin	Isolated	Seasonally flooded/ Permanently saturated	No	<5%	Forested	Trails	No
8	complex: Coniferous treed swamp, graminoid fen, low shrub fen, shrub swamp	16,603	Lentic lake	Basin	Bidirectional-non-tidal /Throughflow	Permanently saturated	Lake	30%	Forested	Cabin	Outlet man-made (constructed lake)
9	open bog	307	Terrene	Basin	Isolated	Seasonally flooded/ Permanently saturated	No	5%	Forested/ Roads	Infill at outlet	Drainage, ditching, and outlet adjustment
10	low shrub fen	7,359	Lentic lake	Basin	Bidirectional-non-tidal	Permanently saturated	Lake	50%	Forested	None	No

Table 6.5-4 Wetland Functional Information

Wetland ID	Wetland Type	Wetland Size (m2)	Landscape Position	Landform	Water Flow Path	Water Regime	Watercourse Association	Standing Water and % cover in wetland	Adjacent Upland Land Use	Stressors	Wetland Hydrology Altered?
11	complex: low shrub bog, mixed wood treed swamp	2,955	Lotic Stream (ephemeral)	Basin	Throughflow	Permanently saturated	No	5%	Forested	None	No
12	complex: Open mixed wood treed swamp, coniferous treed swamp	4,475	Terrene	Basin	Isolated	Seasonally saturated	No	0%	Forested	None, but some rutting and an old clearing	No
13	complex: Treed swamp, coniferous treed swamp	4,816	Terrene	Basin	Throughflow	Seasonally flooded/ Permanently saturated	No	20%	Forested	Dam at outlet	Dam at outlet
14	complex: Shrub bog, Mixed wood treed swamp,	21,528	Terrene / Lotic Stream	Basin	Throughflow	Permanently saturated	Streams	8%	Forested/ Road	None	No

Table 6.5-4 Wetland Functional Information

Wetland ID	Wetland Type	Wetland Size (m2)	Landscape Position	Landform	Water Flow Path	Water Regime	Watercourse Association	Standing Water and % cover in wetland	Adjacent Upland Land Use	Stressors	Wetland Hydrology Altered?
	low shrub fen										
15	graminoid fen	406	Lentic Pond	Basin	Outflow	Permanently saturated	Stream/ Pond	20%	Forested	Access trail	Pond is man-made
16	open shrub swamp	1,321	Terrene	Basin	Outflow- Headwater (inferred)	Permanently saturated	No	<5%	Forested	None	No
17	complex: Tall shrub swamp, coniferous treed bog	72,737	Lentic lake	Basin	Bidirectional- non-tidal/ throughflow	Permanently Saturated, Permanently Flooded	Stream/ Lake	40%	Forested	None	No
18	coniferous treed swamp	1,864	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested	Access trail	No
19	shrub bog	11,428	Terrene	Basin	Isolated	Permanently saturated	No	1%	Forested	Clear-cut	No
20	mixed wood treed fen	10,106	Terrene/Lotic Stream	Basin	Throughflow	Permanently flooded/ Permanently saturated	Stream	25%	Forested/ Road/ Trail	Culverts	Outlet has a culvert
21	mixed wood treed swamp	202	Terrene	Basin	Isolated	Seasonally saturated	No	0%	Forested	Ruts	Surface

Table 6.5-4 Wetland Functional Information

Wetland ID	Wetland Type	Wetland Size (m2)	Landscape Position	Landform	Water Flow Path	Water Regime	Watercourse Association	Standing Water and % cover in wetland	Adjacent Upland Land Use	Stressors	Wetland Hydrology Altered?
22	mixed wood treed swamp	274	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested	None	No
23	coniferous treed swamp	419	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested/ Clear-cut	None	No
24	coniferous treed swamp	328	Terrene	Basin	Isolated	Permanently Saturated	No	0%	Forested/ Clear-cut	Clear-cut	No
25	coniferous treed swamp	1,416	Terrene	Basin	Isolated	Permanently saturated	No	1-2%	Forested	Logging	No
26	coniferous treed swamp	658	Terrene	Basin	Isolated	Permanently flooded	No	100%	Forested	Excess water level - potentially road runoff, but source unknown	No
27	mixed wood treed swamp	493	Terrene	Basin	Outflow-Headwater	Permanently saturated	Stream	5%	Forested	None	No
28	coniferous treed swamp	222	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested	Logging	No

Table 6.5-4 Wetland Functional Information

Wetland ID	Wetland Type	Wetland Size (m2)	Landscape Position	Landform	Water Flow Path	Water Regime	Watercourse Association	Standing Water and % cover in wetland	Adjacent Upland Land Use	Stressors	Wetland Hydrology Altered?
29	complex: Mixed wood treed swamp, low shrub fen, open bog, coniferous treed swamp, coniferous raised bog, graminoid fen	131,498	Lentic lake	Basin	Outflow-Headwater (northern extent) Throughflow (southeastern extent)	Permanently flooded/ Permanently saturated	Lake/ Stream	25%	Forested	Very little	Trenched inlet
30	coniferous treed swamp	964	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested	None	No
31	coniferous treed swamp	6,520	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested	None	No
32	coniferous treed swamp	120	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested	None	No
33	coniferous treed swamp	1,900	Lotic Stream	Basin	Throughflow	Permanently saturated	No	5%	Forested	Trenching	Ditching

Table 6.5-4 Wetland Functional Information

Wetland ID	Wetland Type	Wetland Size (m2)	Landscape Position	Landform	Water Flow Path	Water Regime	Watercourse Association	Standing Water and % cover in wetland	Adjacent Upland Land Use	Stressors	Wetland Hydrology Altered?
34	mixed wood treed swamp	1,382	Terrene	Basin	Isolated	Permanently Saturated	No	0%	Forested/ Clear-cut	Rutting	No
35	coniferous treed swamp	3,376	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested	Road	Road/ Culvert
36	coniferous treed swamp	916	Terrene	Slope	Isolated	Permanently saturated	No	0%	Forested	None	No
37	deciduous treed swamp	253	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested	Old skidder ruts	Surface
38	coniferous treed swamp	388	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested	None	No
39	coniferous treed swamp	1,857	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested	Forest harvest	No
40	coniferous treed swamp	8,091	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested	None	No
41	graminoid marsh	910	Terrene	Basin	Isolated	Seasonally saturated	No	0%	Forested/ Road	None	Unknown; evidence of fluctuation
42	coniferous treed swamp	1,879	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested	Historic logging/ rutting	No

Table 6.5-4 Wetland Functional Information

Wetland ID	Wetland Type	Wetland Size (m2)	Landscape Position	Landform	Water Flow Path	Water Regime	Watercourse Association	Standing Water and % cover in wetland	Adjacent Upland Land Use	Stressors	Wetland Hydrology Altered?
43	mixed wood treed swamp	81	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested/ Logged	None	No
44	coniferous treed bog	10,611	Terrene	Basin	Throughflow	Permanently flooded	No	90%	Forested	Dead and dying woody debris	Beaver dam
45	coniferous treed swamp	295	Terrene	Basin	Isolated	Permanently saturated	No	<5%	Forested	None	No
46	coniferous treed riverine swamp	754	Lotic Stream	Basin	Throughflow	Permanently saturated	Stream	0%	Forested	None	No
47	fresh water marsh	1,029	Terrene	Basin	Isolated	Permanently flooded	No	80%	Forested	Dead and dying woody plants	No
48	coniferous treed swamp	2,876	Terrene	Basin	Throughflow	Seasonally flooded	Stream	0%	Forested/ Road	Dead and dying woody debris	Ditching and abandoned beaver impoundm ent

Table 6.5-4 Wetland Functional Information

Wetland ID	Wetland Type	Wetland Size (m2)	Landscape Position	Landform	Water Flow Path	Water Regime	Watercourse Association	Standing Water and % cover in wetland	Adjacent Upland Land Use	Stressors	Wetland Hydrology Altered?
49	coniferous treed swamp	117	Terrene	Basin	Isolated	Permanently saturated	No	5%	Forested	None	No
50	coniferous tall shrub swamp	117	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested	None	No
51	mixed wood treed swamp	898	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested	None	No
52	coniferous treed swamp	1,620	Terrene	Basin	Throughflow	Seasonally saturated	Stream	0%	Forested	Dead and dying plants/ Blowdown	No
53	low shrub swamp	824	Terrene	Basin	Outflow-Headwater	Permanently saturated	Stream	<5%	Forested/ Clear-cut	None	No
54	coniferous treed bog	416	Lotic	Basin	Isolated	Permanently saturated	No	0%	Forested/ Road	Road	Road
55	mixed wood treed swamp	616	Terrene	Basin	Isolated	Seasonally flooded/ Permanently saturated	No	0%	Forested	Dead and dying woody plants	Ditching into wetland

Table 6.5-4 Wetland Functional Information

Wetland ID	Wetland Type	Wetland Size (m2)	Landscape Position	Landform	Water Flow Path	Water Regime	Watercourse Association	Standing Water and % cover in wetland	Adjacent Upland Land Use	Stressors	Wetland Hydrology Altered?
56	complex: Coniferous treed swamp, tall shrub swamp, low shrub bog	16,275	Terrene	Basin	Throughflow	Permanently flooded/ Permanently saturated	Streams	5%	Forested/ Trails/ Road	Ditching, roads and some infill	Ditching
57	complex: Coniferous treed swamp, deciduous treed swamp	88,769	Terrene	Basin	Outflow-Headwater	Seasonally saturated/ Permanently saturated	Stream	0%	Forested	None	No
58	deciduous treed swamp	581	Terrene	Slope	Isolated	Permanently saturated	No	0%	Forested	None	No
59	coniferous treed swamp	65,348	Terrene	Basin	Throughflow	Permanently flooded/ Permanently saturated	Streams	70%	Forested/ Roads	Drill pads, cutting, roads, flooding, beaver dam, and dead and dying woody plants	Ditching, dam and culvert

Table 6.5-4 Wetland Functional Information

Wetland ID	Wetland Type	Wetland Size (m2)	Landscape Position	Landform	Water Flow Path	Water Regime	Watercourse Association	Standing Water and % cover in wetland	Adjacent Upland Land Use	Stressors	Wetland Hydrology Altered?
60	coniferous treed swamp	2,963	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested	clear cut	No
61	complex: Deciduous treed swamp, tall shrub swamp, open low shrub fen	24,653	Lentic lake	Basin	Throughflow/ Bidirectional-non - tidal	Permanently flooded/ Permanently saturated	Lake	20%	Forested/ Tailings	None	No
62	coniferous treed swamp	832	Lentic lake	Basin	Bidirectional-non - tidal	Permanently saturated	Lake	0%	Forested/ Cameron Flowage	None	No
63	coniferous treed swamp	492	Terrene	Basin	Isolated	Permanently Saturated	No	0%	Forested	No	No
Haul Road											
64	Complex: Low shrub bog, mixed wood treed swamp	15,979	Terrene	Basin	Throughflow	Permanently flooded	No	40%	Forested/ Road	Road	Road
65	open bog	65	Terrene	Basin	Isolated	Seasonally saturated	No	0%	Forested/ Road	Road	Road

Table 6.5-4 Wetland Functional Information

Wetland ID	Wetland Type	Wetland Size (m2)	Landscape Position	Landform	Water Flow Path	Water Regime	Watercourse Association	Standing Water and % cover in wetland	Adjacent Upland Land Use	Stressors	Wetland Hydrology Altered?
66	Complex: graminoid fen, mixed wood treed swamp, high shrub fen	15,423	Terrene	Basin	Throughflow	Permanently flooded	Stream	65%	Forested/ Road	None	Road
67	Complex: low shrub fen, tall shrub fen	1,433	Terrene	Basin	Outflow	Permanently saturated	No	20%	Forested/ Road	None	No
68	Complex: shrub fen, graminoid fen and mixed wood treed swamp	5,579	Terrene	Basin	Throughflow	Seasonally saturated	No	10%	Forested/ Road	None	No
69	Complex: Shrub fen, graminoid fen and mixed wood treed swamp	3,899	Lentic	Basin	Throughflow (inferred from wet areas mapping)	Permanently saturated	Stream	5%	Forested/ Road	None	No
70	tall shrub swamp	631	Terrene	Basin	Isolated (inferred)	Permanently saturated	No	20%	Forested/ Road	None	No

Table 6.5-4 Wetland Functional Information

Wetland ID	Wetland Type	Wetland Size (m2)	Landscape Position	Landform	Water Flow Path	Water Regime	Watercourse Association	Standing Water and % cover in wetland	Adjacent Upland Land Use	Stressors	Wetland Hydrology Altered?
71	deciduous treed swamp	425	Terrene	Basin	Isolated	Seasonally saturated	No	0%	Forested/ Road	None	No
72	deciduous treed swamp	1,471	Terrene	Basin	Outflow	Seasonally saturated	No	0%	Forested/ Road	None	Road
73	Complex: tall shrub swamp, tall shrub fen	26,893	Terrene	Basin	Throughflow	Permanently saturated	No	10%	Forested/ Road	None	No
74	Complex: Mixed wood treed swamp, fresh water marsh	12,340	Terrene	Basin	Throughflow	Permanently flooded	Stream	15%	Forested/ Road	None	Road/ Tree fall
75	mixed wood treed swamp	144	Terrene	Basin	Isolated	Seasonally saturated	No	1%	Forested/ Road	None	No
76	Complex: mixed wood treed swamp, open	10,405	Lotic	Basin	Throughflow	Permanently flooded/ Permanently saturated	Stream	2%	Forested/ Road	Roads, culverts, and garbage	Roads and culverts (2)

Table 6.5-4 Wetland Functional Information

Wetland ID	Wetland Type	Wetland Size (m2)	Landscape Position	Landform	Water Flow Path	Water Regime	Watercourse Association	Standing Water and % cover in wetland	Adjacent Upland Land Use	Stressors	Wetland Hydrology Altered?
	graminoid fen										
77	mixed wood treed swamp	1,204	Terrene	Basin	Throughflow (inferred)	Permanently saturated	No	0%	Forested/ Road	None	Road
78	mixed wood treed swamp	194	Terrene	Basin	Isolated	Seasonally saturated	No	0%	Forested/ Road	None	No
79	coniferous treed swamp	3,703	Terrene	Basin	Throughflow	Permanently saturated	Stream	0%	Forested/ Road/ Trail	None	Road, bridge, and culverts
80	coniferous bog	979	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested/ Road/ Cut block	None	Road
81	tall shrub swamp	154	Terrene	Basin	Isolated	Permanently saturated	No	20%	Forested/ Road	None	No
82	mixed wood treed swamp	616	Terrene	Basin	Isolated	Permanently saturated	No	1%	Forested/ Road	None	No
83	mixed wood treed swamp	535	Terrene	Basin	Isolated (inferred)	Permanently saturated	No	0%	Forested	None	Ditching

Table 6.5-4 Wetland Functional Information

Wetland ID	Wetland Type	Wetland Size (m2)	Landscape Position	Landform	Water Flow Path	Water Regime	Watercourse Association	Standing Water and % cover in wetland	Adjacent Upland Land Use	Stressors	Wetland Hydrology Altered?
84	low shrub swamp	695	Terrene	Basin	Isolated (inferred)	Seasonally saturated	No	0%	Forested/ Road/ Cut block	Rutting/ Clear-cut	Old cut block
85	low shrub swamp	322	Terrene	Basin	Isolated (inferred)	Seasonally saturated	No	0%	Forested/ Road	None	No
86	mixed wood swamp	4,684	Terrene	Basin	Isolated (inferred)	Permanently saturated	No	0%	Forested/ Road	None	No
87	open bog	362	Terrene	Basin	Isolated (inferred)	Permanently saturated	No	5%	Forested/ Road	Rutting. Clear-cut	No
88	tall shrub swamp	417	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested	Rutting	Rutting
89	treed swamp	6,194	Terrene	Basin	Isolated (inferred)	Permanently saturated	No	0%	Forested	Rutting	No
90	mixed wood treed swamp	4,495	Terrene	Basin	Outflow (inferred)	Permanently saturated	No	1%	Forested	Logging road/ Ditching	Ditching
91	mixed wood treed swamp	1,060	Terrene	Basin	Isolated (inferred)	Permanently saturated	No	1%	Forested	None	Ditching

Table 6.5-4 Wetland Functional Information

Wetland ID	Wetland Type	Wetland Size (m2)	Landscape Position	Landform	Water Flow Path	Water Regime	Watercourse Association	Standing Water and % cover in wetland	Adjacent Upland Land Use	Stressors	Wetland Hydrology Altered?
92	mixed wood treed swamp	1,943	Terrene	Basin	Throughflow	Permanently saturated	No	1%	Forested	None	Water passes beneath upland into ditch and joins with WC
93	graminoid marsh	166	Terrene	Basin	Isolated	Permanently flooded	No	90%	Forested/ Road	None	Altered by road
94	mixed wood treed swamp	1,748	Lotic	Basin	Throughflow	Permanently flooded/ Permanently saturated	Stream	20%	Forested/ Road	None	Ditching
95	mixed wood treed swamp	263	Terrene	Basin	Isolated	Permanently saturated	No	2%	Forested	None	No
96	mixed wood treed swamp	861	Terrene	Basin	Isolated (inferred)	Permanently saturated	No	0%	Forested	None	No
97	mixed wood treed swamp	107	Terrene	Basin	Isolated	Permanently saturated	No	30%	Forested/ Road	None	Surface

Table 6.5-4 Wetland Functional Information

Wetland ID	Wetland Type	Wetland Size (m2)	Landscape Position	Landform	Water Flow Path	Water Regime	Watercourse Association	Standing Water and % cover in wetland	Adjacent Upland Land Use	Stressors	Wetland Hydrology Altered?
98	mixed wood treed swamp	1,540	Terrene	Basin	Throughflow	Permanently flooded/ Permanently saturated	Stream	20%	Forested/ Road	None	No
99	mixed wood treed swamp	694	Terrene	Basin	Isolated	Permanently saturated	No	3%	Forested/ Road	None	Cut block
100	shrub swamp	1,582	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested	None	Old clearing
101	clear cut swamp	219	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested	None	Cut block
102	Complex; mixed wood treed bog, mixed wood treed swamp	5,439	Terrene	Basin	Isolated	Permanently saturated	No	15%	Forested/ Road/ Cut block	None	No
103	low shrub bog	455	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested/ Impervio us	None	Cut block
104	low shrub swamp	102	Hillslope	Basin	Isolated	Permanently saturated	No	0%	Forested	None	Old cut block
105	low shrub bog	284	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested	None	Cut block

Table 6.5-4 Wetland Functional Information

Wetland ID	Wetland Type	Wetland Size (m2)	Landscape Position	Landform	Water Flow Path	Water Regime	Watercourse Association	Standing Water and % cover in wetland	Adjacent Upland Land Use	Stressors	Wetland Hydrology Altered?
106	low shrub bog	1,701	Terrene	Basin	Isolated (inferred)	Permanently saturated	No	0%	Forested/ Impervious	None	Old cut block
107	coniferous treed swamp	186	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested	None	No
108	tall shrub swamp	183	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested	None	No
109	coniferous treed swamp	1,606	Terrene	Basin	Isolated	Permanently saturated	No	1%	Forested/ Road/ Cut block	Old cut block	No
110	shrub bog	912	Terrene	Basin	Isolated	Permanently saturated	No	1%	Forested	None	No
111	mixed wood swamp	1,060	Lotic	Basin	Throughflow	Permanently saturated	Stream	5%	Forested	None	No
112	mixed wood swamp	3,595	Terrene	Basin	Outflow-Headwater	Permanently saturated	Stream	8%	Forested	None	No
113	mixed wood treed swamp	1,940	Terrene	Basin	Isolated (inferred)	Permanently saturated	No	3%	Forested	None	No
114	coniferous swamp	242	Terrene	Basin	Isolated	Permanently saturated	No	<5%	Forested	None	No

Table 6.5-4 Wetland Functional Information

Wetland ID	Wetland Type	Wetland Size (m2)	Landscape Position	Landform	Water Flow Path	Water Regime	Watercourse Association	Standing Water and % cover in wetland	Adjacent Upland Land Use	Stressors	Wetland Hydrology Altered?
115	mixed wood treed swamp	582	Terrene	Basin	Isolated (inferred)	Permanently saturated	No	2%	Forested	None	No
116	coniferous swamp	892	Terrene	Basin	Isolated	Seasonally saturated	No	0%	Forested	None	No
117	coniferous swamp	147	Terrene	Basin	Isolated	Seasonally saturated	No	4%	Forested	None	No
118	coniferous swamp	428	Terrene	Basin	Isolated	Permanently saturated	No	2%	Forested	None	No
119	coniferous treed swamp	328	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested	None	No
120	low shrub swamp	115	Terrene	Basin	Isolated	Seasonally saturated	No	0%	Forested	None	No
121	coniferous swamp	154	Terrene	Basin	Isolated	Seasonally saturated	No	0%	Forested	None	No
122	coniferous treed swamp	200	Terrene	Basin	Isolated	Seasonally saturated	No	0%	Forested	None	No
123	mixed wood treed swamp	818	Terrene	Basin	Isolated	Seasonally saturated	No	2%	Forested	None	No
124	mixed wood	528	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested	None	No

Table 6.5-4 Wetland Functional Information

Wetland ID	Wetland Type	Wetland Size (m2)	Landscape Position	Landform	Water Flow Path	Water Regime	Watercourse Association	Standing Water and % cover in wetland	Adjacent Upland Land Use	Stressors	Wetland Hydrology Altered?
	treed swamp										
125	mixed wood treed swamp	344	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested	None	No
126	mixed wood treed swamp	63	Terrene	Basin	Isolated	Seasonally saturated	No	0%	Forested	None	No
127	treed bog	185	Terrene	Basin	Outflow (inferred from wet areas mapping)	Permanently saturated	No	5%	Forested	None	No
128	tall shrub bog	409	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested	None	No
129	treed bog	2,006	Terrene	Basin	Isolated	Permanently saturated	No	2%	Forested	None	No
130	coniferous treed swamp	1,092	Terrene	Basin	Isolated	Permanently saturated	No	3%	Forested	None	No
131	mixed wood treed swamp	1,087	Lotic	Basin	Throughflow	Permanently saturated	Stream	10%	Forested	None	No
132	mixed wood	2,425	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested	None	No

Table 6.5-4 Wetland Functional Information

Wetland ID	Wetland Type	Wetland Size (m2)	Landscape Position	Landform	Water Flow Path	Water Regime	Watercourse Association	Standing Water and % cover in wetland	Adjacent Upland Land Use	Stressors	Wetland Hydrology Altered?
	treed swamp										
133	low shrub bog	102	Terrene	Basin	Isolated	Permanently saturated	No	5%	Forested	None	No
134	treed swamp	398	Terrene	Basin	Isolated	Seasonally saturated	No	5%	Forested	None	No
135	shrub fen	934	Terrene	Basin	Throughflow	Permanently saturated	Stream	0%	Forested	None	No
136	mixed wood treed swamp	522	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested	None	No
137	mixed wood treed swamp	2,404	Terrene	Basin	Throughflow	Permanently saturated	Stream	5%	Forested	None	No
138	shrub bog	1,521	Terrene	Basin	Isolated	Permanently saturated	No	20%	Forested/ Road	None	Road
139	tall shrub bog	106	Terrene	Basin	Isolated	Permanently flooded	No	28%	Forested/ Road	None	Road
140	treed bog	230	Terrene	Basin	Isolated	Seasonally saturated	No	0%	Forested/ Road	None	No
141	high shrub bog	60	Terrene	Basin	Isolated	Permanently flooded	No	40%	Forested/ Road	None	Road

Table 6.5-4 Wetland Functional Information

Wetland ID	Wetland Type	Wetland Size (m2)	Landscape Position	Landform	Water Flow Path	Water Regime	Watercourse Association	Standing Water and % cover in wetland	Adjacent Upland Land Use	Stressors	Wetland Hydrology Altered?
142	low shrub bog	342	Lotic	Basin	Throughflow	Permanently saturated	Stream	2%	Forested/ Road/ Clearing	None	Road
143	Complex: graminoid bog, deciduous treed swamp	526	Lotic	Basin	Throughflow	Permanently saturated	Stream	45%	Forested/ Road	None	No
144	tall shrub fen	2,034	Terrene	Basin	Throughflow	Permanently saturated	Stream	10%	Forested/ Road	None	Road
145	low shrub bog	1,462	Terrene	Basin	Isolated (inferred)	Permanently saturated	No	0%	Forested/ Road	Road	No
146	Complex: graminoid fen, mixed wood treed swamp	2,653	Terrene	Basin	Outflow	Permanently flooded	Stream/Pond	75%	Forested/ Road	None	Road restricting outflow
147	Complex: low shrub bog, mixed wood treed swamp	2,708	Terrene	Basin	Outflow (inferred)	Permanently saturated	No	5%	Forested/ Road	None	No
148	low shrub bog	9,220	Terrene	Basin	Throughflow	Permanently saturated	No	5%	Forested/ Road	Rutting/ Road	No

Table 6.5-4 Wetland Functional Information

Wetland ID	Wetland Type	Wetland Size (m2)	Landscape Position	Landform	Water Flow Path	Water Regime	Watercourse Association	Standing Water and % cover in wetland	Adjacent Upland Land Use	Stressors	Wetland Hydrology Altered?
149	low shrub bog	1,811	Terrene	Basin	Isolated (inferred)	Permanently saturated	No	6%	Forested/ Road	Rutting/ Road	Impoundment of water near road
150	marsh	145	Terrene	Basin	Isolated	Permanently flooded	No	95%	Forested/ Road	Road	No
151	tall shrub bog	2,959	Terrene	Basin	Isolated	Permanently saturated	No	2%	Forested/ Road	Road	No
152	clear cut mixed wood swamp	2,046	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested	Skidder tracks/ Clear-cut	No
153	shrub swamp	2,416	Terrene	Basin	Outflow (inferred)	Permanently saturated	No	5%	Forested	None	No
154	open bog	1,991	Terrene	Basin	Outflow (inferred)	Permanently flooded/ Permanently saturated	No	30%	Forested/ Road	Road	No
155	mixed wood treed swamp	717	Terrene	Basin	Isolated	Temporarily flooded/ Permanently saturated	No	20%	Forested	Road	No
156	shrub bog	14,756	Terrene	Basin	Outflow/head water (inferred)	Permanently saturated	No	1%	Forested/ Road	Road	No

Table 6.5-4 Wetland Functional Information

Wetland ID	Wetland Type	Wetland Size (m2)	Landscape Position	Landform	Water Flow Path	Water Regime	Watercourse Association	Standing Water and % cover in wetland	Adjacent Upland Land Use	Stressors	Wetland Hydrology Altered?
157	Complex: shrub fen, shrub swamp	7,006	Lentic	Basin	Throughflow (inferred from wet areas mapping)	Permanently saturated	No	1%	Forested/ Road	Road	No
158	shrub swamp	575	Terrene	Basin	Isolated	Permanently flooded/ Permanently saturated	No	15%	Forested/ Road	Road	Road
159	mixed wood treed swamp	1,995	Lotic Stream	Basin	Throughflow	Permanently flooded/ Permanently saturated	Stream	15%	Forested/ Road	Road	Beaver dam at outlet
160	freshwater marsh	1,237	Lotic Stream	Basin	Throughflow	Permanently flooded/ Permanently saturated	Stream	60%	Forested/ Road	None	No
161	mixed wood swamp	1,618	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested	Rutting	Ditching
162	mixed wood treed swamp	1,756	Terrene	Basin	Isolated	Permanently saturated	No	5%	Forested	None	Road
163	clear cut swamp	1,107	Terrene	Basin	Isolated	Permanently saturated	No	10%	Forested/ Road	Clear-cut/ Rutting	Rutting

Table 6.5-4 Wetland Functional Information

Wetland ID	Wetland Type	Wetland Size (m2)	Landscape Position	Landform	Water Flow Path	Water Regime	Watercourse Association	Standing Water and % cover in wetland	Adjacent Upland Land Use	Stressors	Wetland Hydrology Altered?
164	mixed wood treed swamp	3,320	Terrene	Basin	Isolated (inferred)	Permanently saturated	No	1%	Forested/ Road	None	No
165	mixed wood treed swamp	1,623	Lotic	Basin	Throughflow	Temporarily Flooded/ Permanently Saturated	Stream	10%	Forested	Road	Input from ditching
166	shrub swamp	68	Terrene	Basin	Isolated	Permanently saturated	No	0%	Forested/ Road	Road	Ditching
167	mixed wood treed swamp	875	Terrene	Basin	Isolated	Permanently saturated	No	3%	Forested/ Road	Road	No
168	Open bog	664	Terrene	Basin	Bidirectional-non-tidal	Permanently saturated	Pond	75%	Forested/ Road	None	No
169	mixed wood treed swamp	607	Terrene	Basin	Isolated (inferred)	Permanently saturated	No	2%	Forested/ Road	Log pile	Culvert at outlet
170	mixed wood treed swamp	1,893	Terrene	Basin	Isolated (inferred)	Permanently saturated	No	0%	Forested	None	No
171	mixed wood	4,329	Riverine	Basin	Throughflow	Permanently saturated	Stream and River (inferred)	10%	Forested/ Road	None	No

Table 6.5-4 Wetland Functional Information

Wetland ID	Wetland Type	Wetland Size (m2)	Landscape Position	Landform	Water Flow Path	Water Regime	Watercourse Association	Standing Water and % cover in wetland	Adjacent Upland Land Use	Stressors	Wetland Hydrology Altered?
	treed swamp										
172	mixed wood treed swamp	229	Terrene	Basin	Isolated	Temporarily flooded/ Permanently saturated	No	5%	Forested/ Road	Rutting/ Clear-cut	Ditching
173	mixed wood treed swamp	4,814	Lotic	Basin	Throughflow	Permanently saturated	Stream	10%	Forested	Skidder tracks	No
174	mixed wood treed swamp	2,513	Terrene	Basin	Outflow	Permanently saturated	Stream	5%	Forested	None	No
175	shrub swamp	611	Terrene	Basin	Outflow (inferred)	Seasonally flooded	No	5%	Forested/ Road	Skidder tracks	No
176	mixed wood treed swamp	446	Terrene	Basin	Isolated (inferred)	Permanently saturated	No	0%	Forested	None	No
177	shrub swamp	755	Terrene	Basin	Isolated (inferred)	Seasonally flooded	No	70%	Forested/ Road	Road	No
178	mixed wood treed swamp	4,439	Terrene	Basin	Isolated (inferred)	Temporarily flooded	No	40%	Forested/ Road	Garbage	Roads

Table 6.5-4 Wetland Functional Information

Wetland ID	Wetland Type	Wetland Size (m2)	Landscape Position	Landform	Water Flow Path	Water Regime	Watercourse Association	Standing Water and % cover in wetland	Adjacent Upland Land Use	Stressors	Wetland Hydrology Altered?
179	mixed wood treed swamp	3,412	Terrene	Basin	Isolated	Seasonally flooded/ Permanently saturated	No	5%	Forested/ Road	None	No

Identification of Exceptional Features

Wetland functional evaluation was completed at each wetland within the PA. As part of this functional assessment, along with a review of the NSE GIS predictive WSS layer, each wetland was reviewed to determine if it meets the threshold for a Wetland of Special Significance (WSS). Wetlands of Special Significance are defined in the Nova Scotia Wetland Conservation Policy (NSE, 2011b, p. 24) as:

> *Areas of bog, fen, marsh, swamp, etc. that play particularly important roles in providing ecosystem services or functions (e.g., supporting rare or migratory species, protecting drinking water supplies, maintaining watershed health). These areas exist on local, watershed, regional, provincial, national and international scales….*

The [Nova Scotia] Government will consider the following to be WSS:

- All salt marshes;
- Wetlands that are within or partially within a designated Ramsar site, Provincial Wildlife Management Area (crown and provincial lands only), Provincial Park, Nature Reserve, Wilderness Area or lands owned or legally protected by non-government charitable conservation land trusts;
- Intact or restored wetlands that are project sites under the North American Waterfowl Management Plan and secured for conservation through the NS–EHJV;
- Wetlands known to support at-risk species as designated under the federal Species at Risk Act; (endangered or threatened) or the Nova Scotia Endangered Species Act (endangered or threatened); and,
- Wetlands in designated protected water areas as described within Section 106 of the Environment Act.

Figures 6.3-3, 6.3-3A to 6.3-3L, and 6.13-1 indicate the proximity of the wetlands identified within the PA to: Ramsar Sites; Provincial Wildlife Management Areas (Crown and Provincial lands only); Provincial Parks; Nature Reserves; Wilderness Areas; Lands owned or legally protected by non-governmental charitable conservation land trusts; intact or restored wetlands under the North American Waterfowl Management Plan; and protected water areas. No wetlands within the PA are present within any of these special habitats, shown on the above-noted figures.

A review of the NSE predictive WSS layer identified two WSS within portions of the PA, Wetland 29 and Wetland 64. Wetland 29 is classified as a predicted WSS by NSE due to the presence of multiple observations of Boreal Felt Lichen (*Erioderma pedicellatum)* (listed as Endangered by SARA/COSEWIC/NSESA) in 2013 (pers.comm. Charles Sangster, NSE). Wetland 64, which exists along the proposed haul road, is identified as a predicted WSS by NSE due to the observations of possible breeding/nesting by an Olive-sided Flycatcher (OSFL) in 2009 (pers.comm. Charles Sangster, NSE).

Although suitable breeding habitat for the OSFL is present within WL64, none were observed at the breeding bird survey point during surveys completed during appropriate breeding periods (i.e. June 13 and 25, 2016). The nearest occurrence of the OSFL identified by MEL during the 2016 field program is approximately 1.7 km to the northeast of WL64. To determine whether the OSFL triggers the designation of a WSS, and to discern associated permitting requirements, additional regulatory consultation is required.

Boreal Felt Lichen was confirmed by MEL during field surveys within Wetland 29 as shown on Figure 6.10-2. However, its location is beyond the footprint of the proposed Project and as such, impacts to it are not expected as a result of the Project.

In addition to WL29, fifteen additional wetlands had a bird SAR observed within or directly adjacent to the wetland (30m) during field surveys completed by MEL. The wetlands-associated SAR bird sightings and the presence of suitable breeding habitat are indicated in Table 6.5-5 below.

Table 6.5-5: Wetlands with Observed Bird SAR and Potential Breeding Habitat

Wetland ID and Type	Observed SAR and Ranks	Suitable Breeding Habitat Present (Y/N)*
WL8-complex: Coniferous treed swamp, graminoid fen, low shrub fen, shrub swamp	Olive-sided Flycatcher (SARA, COSEWIC, NSESA T, S3B)	Y
WL14- complex: Shrub bog, Mixed wood treed swamp, low shrub fen	Olive-sided Flycatcher (SARA, COSEWIC, NSESA T, S3B)	Y
WL29 complex: Mixed wood treed swamp, low shrub fen, open bog, coniferous treed swamp, coniferous raised bog, graminoid fen	Canada Warbler (SARA/COSEWIC T, NSESA E, S3S4B)	Y
WL51- mixed wood treed swamp	Olive-sided Flycatcher (SARA, COSEWIC, NSESA T, S3B)	Y
WL53- low shrub swamp	Chimney Swift (SARA/COSEWIC T, NSESA E, S2B S1M)	N
WL57- complex: Coniferous treed swamp, deciduous treed swamp	Canada Warbler (SARA/COSEWIC T, NSESA E, S3S4B)	Y
WL66- complex: graminoid fen, mixed wood treed swamp, high shrub fen	Canada Warbler (SARA/COSEWIC T, NSESA E, S3S4B)	Y
WL71- deciduous treed swamp	Canada Warbler (SARA/COSEWIC T, NSESA E, S3S4B)	Y

Table 6.5-5: Wetlands with Observed Bird SAR and Potential Breeding Habitat

Wetland ID and Type	Observed SAR and Ranks	Suitable Breeding Habitat Present (Y/N)*
WL72- deciduous treed swamp	Canada Warbler (SARA/COSEWIC T, NSESA E, S3S4B)	Y
WL76- complex: mixed wood treed swamp, open graminoid fen	Canada Warbler (SARA/COSEWIC T, NSESA E, S3S4B)	Y
WL89- treed swamp	Barn Swallow (COSEWIC T, NSESA E, S3B)	N
WL132- mixed wood treed swamp	Canada Warbler (SARA/COSEWIC T, NSESA E, S3S4B)	Y
WL148- low shrub bog	Canada Warbler (SARA/COSEWIC T, NSESA E, S3S4B)	Y
WL156- shrub bog	Olive-sided Flycatcher (SARA, COSEWIC, NSESA T, S3B)	N
WL157- complex: shrub fen, shrub swamp	Olive-sided Flycatcher (SARA, COSEWIC, NSESA T, S3B)	N
WL173- mixed wood treed swamp	Canada Warbler (SARA/COSEWIC T, NSESA E, S3S4B)	Y

* *Preferred habitat for the noted SAR are provided in Table 6.5-6*

Of the four SAR birds identified in wetlands, the Barn Swallow and the Chimney Swift do not utilize wetland habitat for breeding purposes, although they do use wetlands for foraging habitat, specifically water components where insects are present. The Olive-sided Flycatcher prefers conifer forests near meadows and ponds and the Canada Warbler prefers wet forests and riparian shrub forests. Regulatory consultation is required to determine permitting requirements specific to the above wetlands with identified SAR present, including whether these wetlands are designated as a WSS.

Hydrologic Condition and Integrity

The significance of this wetland function is determined by evaluating a wetlands ability to manage water. Landscape and wetland characteristics, such as position in the landscape, connectivity to watercourses, evidence of water detention in the wetland, and vegetation composition and density, combine to determine the capacity of the wetlands to hold water, retard flows and hence maintain downstream flood potential.

The vast majority of all wetlands in the PA are natural, or have been somewhat modified by either historical tree harvesting, access woods roads, or lie adjacent to the existing roads located within the haul road PA. However, a low quantity of wetlands (13 within the mine site PA and 16 within the haul road PA) has been determined important for maintaining stream flows. Conversely, the majority of wetlands within each PA (41 in the mine site PA, and 89 within the haul road PA) provide a high ability to detain surface water, hence reducing peak flows in downstream receptors.

Water Quality

A wetland's ability to provide water quality functions is determined by surrounding landscape conditions, as well as the characteristics of the wetland. Wetland source water from impervious surfaces (developed areas) or land delivering sediment are more likely to possess a higher water quality functional significance than wetlands which are primarily sourced water from undisturbed sources. As well, vegetative density and a wetland's position in the landscape can determine filtering potential that wetlands play in improving water quality. The proximity of a wetland to a downstream fish or water resource is also considered as part of the evaluation.

The NovaWET evaluation determined that almost all (60) wetlands within the mine site PA and 104 of the 116 wetlands identified within the Haul Road PA provide high functional significance for improving water quality.

Groundwater Interactions

NovaWET identifies a recharge wetland as SRFF. However, it is difficult to determine the classification of the groundwater interaction types by visual inspection alone, therefore, although the determination of groundwater versus recharge is identified in Section 6.4.6 the following discussion related to recharge/discharge potential of the wetlands existing in the PA is provided below to supplement the NovaWET results

A wetland is a groundwater discharge area if groundwater moves upwards from underlying soils towards the land surface, whereas recharge wetlands exhibit groundwater that flows vertically downward from the wetland to underlying mineral soils. Groundwater discharge maintains high water tables and wetland habitat, whereas recharge sites replenish aquifers (Siegela, 1988).

Surface water and groundwater interactions across the PA are discussed in detail within Section 6.4.6.

As outlined above, it is difficult to determine groundwater interactions within wetlands by visual inspection alone. It can be assumed, however, that within an area the size of the PA, a combination of discharge and recharge wetlands exist.

Landscape characteristics that are likely to indicate recharge wetlands include:

- Geographically isolated wetlands that contain all water entering them;
- Mineral soils and/or a lack of restrictive sub-surface components that may prevent the downward movement of water and recharge potential;
- Surrounding upland soils prevent the downward movement of water (e.g., clays, shallow bedrock);
- Lack of outlet or restricted outlets, inflow wetlands, and lentic wetlands; and

- Land sloped away from a wetland (e.g., wetlands are elevated in the watershed or near a watershed divide).
- Source: NovaWET 3.0

Wetland composition within the PA includes many isolated wetlands, which provide potential groundwater recharge functions. However, it appears that the majority of wetlands throughout the mine footprint PA, especially those major wetland complexes situated at the tertiary watershed divide (wetlands 1, 2, 29 and 57), contain watercourse outlets draining via additional throughflow wetlands toward Crusher Lake, Mud Lake, and, ultimately, Cameron Flowage. These wetlands, as well as the throughflow wetlands, which intercept water from these systems, are more likely to exist as groundwater discharge wetlands via surface water flows (e.g., perennial watercourses, drainage channels, sheet flow, etc.). As discussed in Section 6.2.3, underlying bedrock geological conditions within the mine footprint PA (and on a regional basis) are comprised of greywacke and slate found in the region, which as a result of their impermeability and poorly jointed rocks, act as a confining layer throughout the region. This results in the majority of water sourced to the wetlands via precipitation, snow melt, and surface runoff/sheet flow, being drained across the surface (via wetlands, watercourses, and other micro-surface features) in a discharge fashion.

The same can be said for wetlands existing within the Haul Road PA. A scattering of isolated wetlands exists within the PA and provide some groundwater recharge functions. However, their relative size and limited water source (e.g., precipitation and small scale surface water runoff) reduces their ability to affect groundwater recharge at a landscape level. The majority of wetlands throughout the Haul Road PA acts as throughflow or outflow features and, therefore, acts as groundwater discharge features.

Fish and Wildlife Habitat and Integrity

Results of the NovaWET evaluations determined that seven wetlands within the mine footprint PA (wetlands 8, 10, 17, 29, 56, 59, and 61) provide high functional significance for wildlife and fish habitat. Eleven wetlands provide a high functional significance for the same functions within the Haul Road PA (wetlands 64, 66, 68, 69, 79, 146, 154, 157, 159, 160, and 171). The determination of high significance was afforded to these wetlands as a result of the wetlands' association with potential fish passage via connected watercourses, fish habitat the wetland provides, and access to open water habitat to support migratory birds.

Apart from multiple species of birds, no priority wildlife species were identified in wetlands within the PA during field evaluations. However, although not directly observed, wetlands identified within the PA provide potential habitat for priority wildlife species (e.g., Maritime shrew (S3) and the rock vole (S2)) which have been documented within 5 km of the PA. The fisher (*Martes pennanti* (S2)) is a largely nocturnal hunter with large home ranges and elusive behavior. Evidence of the mainland moose (tracks) was identified approximately 20 m north of wetland 56 in the northern portion of the mine footprint PA, as well as beyond the northwestern PA boundary. The mainland moose uses wetlands to access submerged and emergent aquatic vegetation during summer and often seek out streams, ponds, and shorelines of lakes in summer to escape heat and insects (NSDNR, 2007).

The snapping turtle (SARA SC, NSESA V), which was identified in two locations during field studies (one along Highway 224 as it intersects the Haul Road PA and one along Mooseland Road), is a species which requires wetland habitat as part of its life cycle activities. Wetlands within the PA which provide suitable habitat for this species include wetlands 8, 10, 17, 29, 59, 61, 66, 68, 69, 159, 168, and 171. These wetlands all provide standing water to a depth exceeding 0.5 m, therefore, it is presumed that the open water portions of these wetlands provide potential overwintering habitat for snapping turtles.

Approximately a third (23) of the wetlands in the mine site PA have been determined to provide life cycle supporting habitat for fish species or provide other habitat support to fish (e.g., riparian vegetation, water quality, buffer functions) as a result of their association with watercourses. Whereas, just under a quarter (25) of the wetlands identified in the Haul Road PA provide these functions. Wetlands 61,171, 173, and 174 have been determined to provide habitat for fish species of commercial, aboriginal, or recreational importance (e.g., brook trout, American eel, small-mouthed bass). No priority fish species were identified within wetlands, with the exception of expected fish habitat for American eel within wetland 171.

Multiple priority bird species were identified within and in close proximity to wetlands during point count bird surveys and via incidental sightings during field assessments completed throughout the PA. In addition, focused bird surveys (point counts) were completed in many other habitat types and locations throughout the PA that do not constitute wetland habitat. A full list of priority bird species observed within the PA is provided in Section 6.9.3. The list was narrowed down to priority bird species that were identified at point locations within, and directly adjacent to, wetland habitat, and that use wetlands as part of their preferred breeding habitat. These species are listed in Table 6.5-6, together with the preferred wetland habitat.

Table 6.5-6 Observed Bird Priority Species and Wetland Habitat Association

Bird Species	Preferred Wetland Habitat
Eastern Wood-Pewee	Wooded habitat, in riverside habitat
Canada Warbler	Wet forests, riparian shrub forests
Rusty Blackbird	Wet forests including fens, bogs, swamps and beaver pond
Spotted Sandpiper	Semi-open area near shoreline of ponds, lakes, river and streams
Greater Yellowlegs	Muskeg, wet bogs, marshes
Wilson's Snipe	Wet, marsh, bogs, fens alder and willow swamps, wet meadows
Northern Harrier	Nest on ground in grassland and wetland vegetation- marshes
Yellow-bellied Flycatcher	Boreal coniferous forests and peatlands, bogs, swamps and muskeg
Tennessee Warbler	Bogs, swamps and forests
Olive-sided Flycatcher	Conifer forests near meadows and ponds

The NovaWET evaluation determined that at least one SAR bird was identified at point count locations within or directly adjacent to seven wetlands in the mine site PA and 12 wetlands within the Haul Road PA. At least one SOCI bird was identified at point count locations within or directly adjacent to 13 wetlands in the mine site PA and 25 wetlands within or adjacent to wetlands within the Haul Road PA. It should be noted, however, that these observations are based on detection points (e.g., point count locations) and do not specify whether the bird identified is using, or how it might be using, the wetland habitat as its preferred habitat.

Shoreline Stabilization and Integrity

The ability for a wetland to stabilize and provide stabilizing support to shorelines is determined initially by the association the wetland has with a watercourse (stream, lake, pond, etc.) or tidal features (e.g., estuary, ocean). Other factors that determine the significance a wetland may play in providing these functions include vegetation characteristics (e.g., density, widths, species type, streambank colonization), but also the characteristics of the waterbody to which the wetland is adjacent (e.g., subjected to wave action, high flows, and other erosive forces).

As a result of the NovaWET evaluations, nine wetlands (wetlands 4, 8, 10, 14, 17, 29, 44, 48, and 61) within the mine footprint PA provide a high functional significance in this regard, whereas seven wetlands (wetlands 66, 69, 74, 76, 79, 157, and 171) provide a high functional significance within the Haul Road PA.

Plant Community

None of the wetlands comprise plant communities that are rare regionally or provincially. As discussed in information provided earlier in this section, wetlands present within the PA include treed and shrub swamps, bog, fen, marsh, and wetland complexes comprising variations of each wetland type. Wetland vegetation composition within all wetland habitats is typical to those existing in similar habitat throughout the province. Treed and shrub swamps are predominantly coniferous or mixed wood, with lesser amounts of deciduous swamp occurring. Bog habitats within the PA vary between low and high shrub bogs to treed bogs, and areas of fen habitat predominantly comprise low shrubs or exist entirely as graminoid features. The few marsh habitats identified consist entirely of graminoid vegetation.

Table 6.5-7 provides the dominant species per wetland habitat type that wetlands within the PA support. Dominant vegetation on a per wetland basis is provided in the Wetland Characterization Table (**Appendix G**).

Table 6.5-7 Dominant Vegetation Supported by Wetland Habitat within the Project Area

Wetland Habitat Type	Dominant Species Supported
Treed and Shrub Swamps	Balsam Fir, Black and Red Spruce, Red Maple, Yellow Birch, Mountain Holly, Cinnamon Fern, Three-seeded Sedge, Canada Bunchberry, Bristly Dewberry.
Shrub and Treed Bogs	Tamarack, Black Spruce, Balsam Fir, Speckled Alder, Balsam Fir, Sheep Laurel, Labrador Tea Leatherleaf, Cinnamon Fern, Bog Fern, Three-seeded Sedge.
Graminoid and shrub Fen	Red Maple, Black Spruce, Tamarack, Wild Raisin, Common Winterberry, Atlantic Sedge, Bog Cranberry, Royal Fern.
Graminoid Marsh	Bluejoint Reed Grass, Harlequin Blue Flag, Tussock’s Sedge, Common Woolly Bulrush, Canada Manna Grass.

Overall plant integrity within wetlands was determined via the NovaWET process by evaluating

Overall plant integrity within wetlands was determined via the NovaWET process by evaluating
specific vegetative characteristics within wetlands identified during the study. Characteristics include presence of invasive or exotic species, extent of disturbances, vegetative density, and the presence of rare or endangered species (priority species).

The evaluation concluded that approximately half (29) of the mine footprint PA wetlands were rated as comprising a highly significant diversity of species, whereas 25 of the 116 wetlands within the Haul Road PA are also rated as such.

Six wetlands (wetlands 4, 12, 14, 17, 29, and 33) comprise at least one priority plant species (vascular and non-vascular) within the mine footprint PA and eight wetlands (wetlands 80, 115, 129, 135, 137, 147, and 157) comprise priority plant species in the Haul Road PA. Apart from wetland 29, which contains the boreal felt lichen (SARA/COSEWIC/NSESA), a federally listed SAR, all priority species identified in the wetlands exist as SOCI. As such, wetland 29 is a WSS, although, as discussed in *Identification of Exceptional Features* subsection above, the location of the boreal felt lichen observed during field surveys is located beyond the PA boundary, albeit in a wetland which extends into the PA. Therefore, impacts to this species as a result of Project activities are not expected.

The overall integrity and quality of plants has been determined to be high in over half of the wetlands identified in the mine footprint PA (35) and the Haul Road PA (61), likely as a result of minimal disturbance in land use surrounding the wetlands and/or few direct activities, such as tree harvesting and existing roads, within the wetlands existing in the PA.

Community Use/Value

Community use and value of wetlands include, among others, access and visibility for humans to complete activities such as hunting, recreational, wildlife viewing, plant and berry gathering, fishing, etc.

The large majority of wetlands identified in the PA have been determined to provide a low functional significance for community use and value, largely as a result of inaccessibility to humans. No wetlands have been determined to provide a high significance for this function.

6.5.4 Consideration of Consultation and Engagement Results

Key issues raised during public consultation and Mi’kmaq engagement relating to wetlands include direct impacts during construction activities at the Beaver Dam mine site and during haul road construction, as well as potential indirect effects from Project activities. Overall potential effects on habitat loss from direct and indirect wetland impacts was cited as a concern, including potential effects to use by Mi’kmaq peoples for hunting, fishing, trapping, and gathering.

The results of the public consultation and Mi’kmaq engagement have been considered in the environmental effects assessment, including the Proponent’s commitments on mitigation and monitoring measures and proposed compliance and effects monitoring programs, as well as the Proponent’s broader commitment to ongoing public consultation and Mi’kmaq engagement. Specific to evaluating the effect on wetlands, these are found within the following environmental effects assessment.

6.5.5 Effects Assessment Methodology

6.5.5.1 Boundaries

Spatial Boundaries

The spatial boundaries used for the assessment of effects to wetlands are the Project areas (PA) for the mine footprint and the haul road, and the LAA consisting of surface water systems immediately adjacent to and receiving drainage from the PA.

Temporal Boundaries

The temporal boundaries used for the assessment of effects to wetlands are the construction phase, operational phase, and decommissioning and reclamation phase.

Technical Boundaries

No technical boundaries were identified for the effects assessment of wetlands.

Administrative Boundaries

Administrative boundaries for the protection and conservation of wetland habitat in Nova Scotia include the Nova Scotia Wetland Conservation Policy (2011b), the Environmental Goals and Sustainable Prosperity Act (EGSPA 2007) and the Environment Act (1994) and its' Activities Designation Regulations (1995).

Further wetland protection is provided on a federal level by the Federal Policy of Wetland Conservation (1991).

6.5.5.2 Thresholds for Determination of Significance

A significant adverse effect from the Project on wetlands is defined as an effect that is likely to cause a permanent net loss of wetland function. An adverse effect that does not cause a permanent net loss in wetland function is considered to be not significant.

6.5.6 Project Activities and Wetlands Interactions and Effects

Potential interaction between Project activities and wetland habitat within the PA is outlined in Tables 6.5-8 and 6.5-9 below.

Table 6.5-8 Potential Wetland Interactions with Project Activities at Beaver Dam Mine Site

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Clearing, grubbing, and grading in preparation of construction • Rock blasting in preparation of construction • Till and waste rock from site preparation transport and storage • Existing settling pond dewatering in preparation of construction • Watercourse and wetland alteration in preparation of construction • Mine site road construction • Surface infrastructure installation and construction • Collection and settling pond construction • Environmental monitoring of surface water discharges and adjacent wetlands • General management of wastes derived from preparation and construction activities • Accidents and malfunctions to include fuel and other spills, forest fires, settling pond overflow, slope failure, an unplanned explosive event, and mobile equipment accidents
Operation and Maintenance	3-4 years	• Rock blasting to access and extract ore • Surface mine dewatering to facilitate access to and extraction of ore • Management of waste rock produced from crushing and preparing ore for transport • Treatment of site surface water runoff and surface mine pumped water • Petroleum products management • Environmental monitoring of surface water discharges and adjacent wetlands • General management of wastes derived from operation and maintenance activities • Accidents and malfunctions to include fuel and other spills, forest fires, settling pond overflow, slope failure, an unplanned explosive event, and mobile equipment accidents
Decommissioning and Reclamation	1-2 years	• Site reclamation activities • Environmental monitoring of adjacent wetlands • General management of wastes derived from decommissioning and reclamation activities • Accidents and malfunctions to include fuel and other spills, forest fires, and mobile equipment accidents

Table 6.5-9 Potential Wetland Interactions with Project Activities along Haul Road

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Clearing, grubbing, and grading in preparation of construction • Rock blasting in preparation of construction • Till and waste rock from site preparation transport and storage • Watercourse and wetland alteration in preparation of construction • Haul road construction and upgrades • Environmental monitoring of adjacent wetlands • General management of wastes derived from preparation and construction activities • Accidents and malfunctions to include fuel and other spills, forest fires, and a haul truck accident
Operation and Maintenance	3-4 years	• Haul road maintenance and repairs, including salting • Environmental monitoring of adjacent wetlands • Accidents and malfunctions to include fuel and other spills, forest fires, and a haul truck accident
Decommissioning and Reclamation	-	N/A[1]
1 Decommissioning and Reclamation of the Haul Road is not expected. The haul road will be returned to owner for forestry industry		

Table 6.5-10 Potential Wetland Interactions with Project Activities at Touquoy Processing and Tailings Management Facility

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Accidents and malfunctions to include fuel and other spills, forest fires, and mobile equipment accidents
Operation and Maintenance	3-4 years	• Environmental monitoring of surface water discharges and adjacent wetlands • General management of waste derived from processing activities • Accidents and malfunctions to include fuel and other spills, forest fires, and a haul truck accident
Decommissioning and Reclamation	1-2 years	• Environmental monitoring of surface water discharges and adjacent wetlands • Accidents and malfunctions to include fuel and other spills, and forest fires

6.5.6.1 Wetland Impacts

Development of the mine and haul road will cause direct and indirect impacts to wetlands mostly during the construction phase of the Project. Direct impacts will be associated with clearing, grubbing, infilling, and development of the mine and its associated infrastructure. Along the Haul Road, upgrading of the road (widening and new sections of road as needed) will account for the greatest impact to wetland habitat. Indirect impacts are a by-product of direct impacts associated with the construction activities, as well as potential indirect impacts to wetlands from mine operations (dewatering, blasting, and accidents). Table 6.5-10 provides general impact types and a description of various direct and indirect examples by which these may occur as a result of Project activities. Detailed discussion regarding potential impacts to groundwater recharge as a result of wetland loss associated with the Project is included after Table 6.5-10.

The Touquoy facility is currently under construction. There are no direct or indirect effects to wetlands anticipated to be caused by the processing of ore and the management of tailings from the Beaver Dam Mine Project. The use of the Touquoy facility for the processing of Beaver Dam ore will not involve construction or operation of the mine site, use of the Tailings Management Facility, or discharge of effluent into surface water bodies and adjacent wetlands; therefore, no effects are anticipated at the Touquoy facility related to the processing of Beaver Dam ore, with the exception of the continued potential for accidents and malfunctions and continued environmental monitoring.

Table 6.5-11 Direct and In-Direct Wetland Impacts

Impact Type	Direct Impact	Project Phase1	Indirect Impact	Project Phase1
Alteration of Wetland Hydrology: If the hydrological regime of a wetland is altered, the vegetation, character, and function of the wetland also have potential to change.	Complete dewatering (removing wetland), infilling or flooding of a wetland to facilitate Project development resulting in conversion from wetland to upland habitat.	C	Hydrologically connected upstream wetlands may also be at risk of indirect impacts as a result of downstream alteration activities (e.g., water outflow changes, land elevation changes, blasting, etc. causing dewatering). Inadvertent damming of up-gradient wetlands from construction related infrastructure (e.g., roads with lack of flow through infrastructure).	C/D
	Alteration of hydrological inputs and outputs into partially altered wetlands has the potential to alter remaining (undeveloped) wetland habitat.	C/O/D	Removal of on-site outflow and throughflow wetland habitat has the potential to alter the localized hydrology in downgradient wetlands.	C
			Hydrological changes can affect the use of the wetland by wildlife as habitat.	C
			Blasting adjacent to wetlands has the potential to alter subsurface water flows, especially in fractured rock. This activity has the potential to increase or decrease subsurface hydrological flow to adjacent wetland habitats and can precipitate drier (dewatering) or wetter conditions in those habitats.	C/O
Alteration of Water Quality:	Removal (alteration) of wetland from the landscape leading to reduced or no water supply to downgradient aquatic receivers (e.g., streams, additional wetlands, and lakes).	C/O/D	Alteration of the wetlands increases the risk of downgradient sedimentation.	C/O/D
			The effects of increased sedimentation as a result of up-gradient activities (e.g., earth moving, removal of vegetation, soil stockpiling) has the capacity to suffocate existing plant life and increase nutrient levels in downgradient wetlands. Dust created as a result of construction activities can have a similar impact.	C/O/D
			Runoff from acid producing rock exposed during construction and operations activities has the potential for negatively altering water quality within downgradient wetland habitat.	C/O/D

Table 6.5-11 Direct and In-Direct Wetland Impacts

Impact Type	Direct Impact	Project Phase1	Indirect Impact	Project Phase1
Vegetative and Habitat Integrity:	Extensive ground works, including activities such as blasting in and adjacent to wetlands has the potential to destabilize land surfaces and the root zone of vegetative areas, including wetland buffers.	C/D	Introduction of invasive species can occur indirectly into wetlands when equipment or people enter the wetlands or via runoff or dust from the roads. Introduction of mine and Haul Road traffic during construction and operation can elevate this risk. Invasive species, such as purple loosestrife (Lythrum salicaria), can severely degrade wetland habitat and function. No purple loosestrife was noted during field surveys in the mine footprint or Haul Road PA.	C/O/D
	Loss of vegetative cover decreases wildlife habitat availability and also has the potential to reduce natural surface water drainage.	C	Dust accumulation on vegetation can smother and stress the plants. The dust can also provide minerals and nutrients into the wetland habitat.	C/O/D
	Seeds and roots of invasive species can be transferred from construction equipment, transportation vehicles, or workers into adjacent wetland habitat during construction and operational activities.	C/O/D		
Malfunctions and Accidents: Accidental spills of contaminants in up-grade work areas has the potential to drain into down-gradient wetlands, and can cause negative impact to wetland function, and potential use of the habitat by wildlife.				C O D

[1] C = Site Preparation and Construction Phase O = Operation and Maintenance Phase D = Decommissioning and Reclamation

6.5.6.2 Impacts to Groundwater Recharge

As discussed earlier in this section, the PA comprises a combination of groundwater recharge and discharge wetlands, although discharge wetlands appear to dominate the landscape. Smaller isolated wetlands have the ability to hold water for longer and allow penetration of surface water into the relatively impermeable bedrock geology. Removal of recharge wetlands form the landscape removes the ability for water to be collected, stored, and fed into underlying aquifers. However, once other water loss factors such as evapotranspiration have been accounted for, the loss of smaller recharge wetlands (e.g., isolated features lacking an outlet and/or lentic wetlands located adjacent to lakes) is not expected to affect groundwater levels on a landscape level.

Proposed wetland impacts within the Cameron Flowage tertiary watershed encompass varied wetland habitats, including portions of the larger headwater wetland complexes (wetlands 2 and 29) in southern portions of the PA, which are acting as discharge systems. Proposed wetland impact areas within these complexes appear to be located at their northern extents, in closer proximity to their discharge points (streams). As such, the wetland impact areas are likely not affecting critical groundwater recharge functions to any large degree at these locations; rather, discharge of water to lower lying aquatic receptors is more likely.

From the headwater position, water flows via throughflow wetlands and streams toward Crusher Lake, and in the case of wetland 57, directly toward Cameron Flowage. These wetlands offer minimal groundwater recharge capacities; therefore, their alteration is unlikely to affect groundwater recharge.

A collection of isolated wetlands exists in northern portions of the Kent Lake tertiary watershed, in land encompassing the future Waste Rock Storage Area, and in between Crusher Lake, Mud Lake, and Cameron Flowage. As discussed, these isolated wetlands are more likely to provide groundwater recharge abilities than those which are part of continuous wetland throughflow systems. Based on the proposed Project design within the Mine Study Area, many of these wetlands will be completely altered as a result of Project infrastructure. Of note, however, is the limited size of these wetlands in comparison with other, non-isolated wetlands present within the PA. It is not anticipated that alteration of the smaller isolated wetlands will bear critical impact to groundwater recharge capacity, especially at a more regional scale (i.e., secondary watershed level).

In most cases, the other larger lentic wetlands adjacent to Crusher Lake, Mud Lake, and Cameron Flowage receive water from up-gradient systems, as well as bi-directional water flow from the lakes themselves and, hence, act as discharge features. Apart from some partial impact to the outer edges of these wetlands, for the most part, these wetlands will not be altered as a result of the Project. On-site water will be managed via the construction of water settling ponds and a diversion channel. The diversion channel will act as a mechanism to transport water from southern portions of the mine infrastructure to Cameron Flowage, with a goal of maintaining current water input into the lake. Therefore, water currently being sourced by Cameron Flowage into wetland 61 by bi-directional flow for example, will be maintained.

Wetlands being impacted as a result of the Haul Road upgrades also comprise a variety of characteristics which determine them to act as discharge or recharge wetlands. Regardless of wetland type, size, or local landscape conditions, etc., the proposed upgrades to the Haul Road are minimal (e.g., narrow infill for road widening or new sections of road where necessary to manage site lines and turning radii) and hydrological flow within the wetland will be maintained beneath the road via installation of culverts (or other accepted methods). As such, the ability for the wetland to maintain existing groundwater recharge functions (should it currently do so) will not be affected by the proposed activities.

The following summary is provided:

- The variability of wetland types and landscape conditions (e.g., soil types, landscape position, geological conditions) present within the PA determines a wetland's ability to perform groundwater discharge or recharge functions;
- The PA is dominated by surface flow and groundwater discharge wetlands as a result of underlying impermeable geological conditions;
- Isolated wetlands scattered throughout both the mine and haul road sites are likely to provide groundwater recharge functions, however, due to their small size and limited source of water (precipitation and surface runoff), alteration of these wetlands is not expected to impact groundwater recharge at the landscape level; and,
- Within the Mine Study Area, proposed infrastructure design involves the partial alteration of large, headwater complexes, multiple throughflow systems, and multiple small isolated wetlands. The large wetland complexes comprise outflow/discharge points and, as such, groundwater discharge is likely occurring. Isolated wetlands are small in size, especially in comparison to the regional setting (i.e., secondary watershed). Minimal disturbance is planned within lentic wetlands. There are no expansive or contiguous areas of wetland habitat performing groundwater recharge functions expected to be altered as part of the Project. For these reasons, wetland alteration associated with the Project is not expected to alter groundwater recharge capacity. Conversely, due to the anticipated alteration footprint on discharge wetlands, surface water flows from headwater positions, toward lower lying receiving wetlands (e.g., surrounding Crusher and Mud Lakes and Cameron Flowage) are expected to be altered. Diversion channels, settling pools, and other Project infrastructure will be constructed to manage potential surface water imbalances and/or reductions in drainage toward lower lying receptor wetlands (refer to Section 6.3 Surface Water Quality and Quantity).

6.5.6.3 Wetland Impact Extent

Direct Impacts

Expected direct impact extent as a result of Project activities during the temporal lifetime of the mine are described in Table 6.5-11 for the mine site PA and Table 6.5-12 for the haul road PA. Indirect hydrological and water quality wetland impacts to adjacent wetlands within the PA that may be expected as a result of the Project, as well as those within the haul road PA are discussed separately.

The following potential direct impact extents are included in the Tables 6.5-11 and 6.5-12. Only wetlands where expected direct habitat alteration is expected are included in these tables.

P – Partial habitat loss of wetland

C – Complete habitat loss of wetland

Table 6.5-12 Expected Direct Wetland Impacts (Hydrological and Water Quality) within the Mine Site PA

Wetland #	Wetland Size (m2) inside PA	Estimated Direct Impact Area (m2)	Infrastructure	Direct Impact Type
2	196,857	78,051	waste rock storage	P
3	4,658	4,658	waste rock storage	C
4	13,139	494	waste rock storage	P
5	6,202	4,708	waste rock storage/topsoil stockpile	P
6	262	262	topsoil stockpile	C
7	306	306	till stockpile	C
8	16,603	1,835	till stockpile	P
11	2,955	51	waste rock storage	P
13	4,816	4,816	waste rock storage	C
14	21,528	3,349	till stockpile	P
17	72,737	7,730	open pit	P
19	11,428	2,211	open pit	P
20	10,106	10,106	till stockpile/open pit	C
21	202	202	waste rock storage	C
22	274	274	waste rock storage	C
23	419	419	waste rock storage	C
24	328	116	waste rock storage	P
25	1,416	1,416	waste rock storage	C
26	658	658	waste rock storage	C
27	493	493	waste rock storage	C
28	222	21	waste rock storage	P
29*	131,498	42,717	waste rock storage	P
30	964	686	waste rock storage	P
31*	6,520	1,177	waste rock storage	P
33	1,900	1,900	waste rock storage	C
34	1,382	1,382	till stockpile	C
35	3,376	3,376	waste rock storage	C

Table 6.5-12 Expected Direct Wetland Impacts (Hydrological and Water Quality) within the Mine Site PA

Wetland #	Wetland Size (m2) inside PA	Estimated Direct Impact Area (m2)	Infrastructure	Direct Impact Type
36	916	916	waste rock storage	C
37	253	253	waste rock storage	C
38	388	388	waste rock storage	C
39	1,857	1,857	waste rock storage	C
40	8,091	1,984	waste rock storage	P
41	910	910	waste rock storage	C
42	1,879	1,879	waste rock storage	C
43	81	81	waste rock storage	C
44	10,611	10,611	waste rock storage	C
45	295	295	waste rock storage	C
46	754	754	waste rock storage	C
47	1,029	1,029	waste rock storage	C
48	2,876	2,876	waste rock storage	C
49	117	117	waste rock storage	C
50	117	117	waste rock storage	C
51	898	898	waste rock storage	C
52	1,620	1,620	waste rock storage	C
53	824	824	waste rock storage	C
54	416	416	waste rock storage	C
55	616	616	open pit	C
56	16,275	16,275	open pit	C
57*	88,769	34,502	ore stockpile/ROM & facilities/water diversion/roads	P
59	65,348	63,432	open pit	P
61*	24,653	1,229	open pit	P
Total Impact Area: Mine Footprint		**317,293**	**Total complete wetland alteration**	**34**
			Total partial wetland alteration	**17**

** Indicates total wetland area within PA: wetland extends off-site beyond the PA boundary*

As outlined in Table 6.5-10, 34 wetlands will be completely altered and 17 wetlands will be partially altered as a result of mining activities and associated infrastructure within the mine footprint PA.

Expected direct impact extent to wetlands as a result of Project activities during the temporal lifetime of the Project are described in Table 6.5-11 for the haul road PA. Only wetlands with expected direct impacts are included.

Table 6.5-13 Expected Direct Wetland Impacts within the Haul Road PA

Wetland #	Wetland Size (m2) inside PA	Estimated Direct Impact Area (m2)	Infrastructure	Direct Impact Type
64	15,979	159	road upgrade	P
65	65	28	road upgrade	P
66*	15,423	1,136	road upgrade	P
68*	5,579	1	road upgrade	P
69*	3,899	108	road upgrade	P
70*	631	188	road upgrade	P
72	1,471	178	road upgrade	P
73*	26,893	2,537	road upgrade	P
74*	12,340	1,135	road upgrade	P
75	144	1	road upgrade	P
76*	10,405	354	road upgrade	P
79*	3,703	303	road upgrade	P
80*	979	6	road upgrade	P
81	154	90	road upgrade	P
82*	616	1	road upgrade	P
86*	4,684	855	road upgrade	P
89*	6,194	290	road upgrade	P
94*	1,748	308	road upgrade	P
98*	1,540	377	road upgrade	P
109	1,606	253	new road	P
111*	1,060	7	new road	P
112*	3,595	256	new road	P
116	892	11	new road	P
120	115	84	new road	P
123	818	189	new road	P
124*	528	72	new road	P
125	344	102	new road	P
126	63	3	new road	P
133	102	13	new road	P
136	522	214	new road	P
138	1,521	720	road upgrade	P
139	106	1	road upgrade	P

Table 6.5-13 Expected Direct Wetland Impacts within the Haul Road PA

Wetland #	Wetland Size (m2) inside PA	Estimated Direct Impact Area (m2)	Infrastructure	Direct Impact Type
142	342	30	road upgrade	P
143	636	25	road upgrade	P
144*	2,034	80	road upgrade	P
145*	1,462	321	road upgrade	P
146*	2,653	329	road upgrade	P
147*	2,708	345	road upgrade	P
148*	9,220	1,834	road upgrade	P
149*	1,811	1,134	road upgrade	P
150	145	107	road upgrade	P
151*	2,959	614	road upgrade	P
153*	2,416	92	road upgrade	P
154*	1,991	626	road upgrade	P
155*	717	175	road upgrade	P
156*	14,756	1,479	road upgrade	P
157*	7,006	3,181	road upgrade	P
158	575	209	road upgrade	P
159*	1,995	700	road upgrade	P
160*	1,237	93	road upgrade	P
161*	1,618	377	road upgrade	P
162*	1,756	321	road upgrade	P
163*	1,107	329	road upgrade	P
164*	3,320	479	road upgrade	P
166	68	68	road upgrade	C
167*	875	227	road upgrade	P
168*	664	56	road upgrade	P
169*	607	50	road upgrade	P
171*	4,329	32	road upgrade	P
172	229	48	road upgrade	P
173*	4,814	7	road upgrade	P
176*	446	62	road upgrade	P
179	3,412	90	road upgrade	P
Total Impact Area: Haul Road		**23,500**	**Total complete wetland alteration**	**1**
			Total partial wetland alteration	**62**

** Indicates total wetland area within PA: wetland extends off-site beyond the PA boundary*

As outlined in Table 6.5-12, 1 wetland will be completely altered and 62 wetlands will be partially altered as a result of haul road construction and upgrading activities. In total, across the entire PA, a total of 35 wetlands are expected to be completely altered to support Project development, and 79 wetlands are expected to require partial alteration to support Project infrastructure and development.

Indirect Wetland Impacts

Potential hydrological and water quality related indirect impact types are also anticipated in the mine footprint and Haul Road PA. In addition, due to the nature of proposed activities (e.g., active construction site, presence of vehicles and construction equipment), all wetlands identified within the PA have potential to be indirectly impacted as a result of accidents and malfunctions. Mechanisms to reduce the potential for vegetative and habitat impacts from accidents and malfunctions will be addressed and discussed in Section 6.5.7.

Potential for downgradient, indirect wetland impacts can be expected throughout the mine footprint PA as a result of up-gradient hydrological alteration. Primarily, the alteration of hydrological conditions in up-gradient wetlands and watercourses will affect natural inflows, outflows, and hydroperiod characteristics in contiguous wetland systems. In addition, where up-gradient alteration is occurring, but a direct hydrological flow is being maintained, potential exists for indirect impacts to downgradient water quality conditions. Within the mine site PA, areas with heightened risk of these indirect impact types include wetlands (and associated watercourses) bordering Crusher Lake (i.e., wetlands 4, 8, 10, and 11) due to them directly receiving water from up-gradient wetlands and watercourses which are subject to alteration (e.g., headwater and throughflow wetlands). Similarly, wetlands 20, 14, and 17, all of which act as throughflow wetlands that intercept water prior to it draining into Mud Lake, are also at potential risk of indirect hydrological and water quality impacts as a result of up-gradient alteration activities. At the eastern extent of the mine footprint PA, alteration to wetland 57, a headwater wetland, has the potential to indirectly impact its downgradient aquatic receptors, which include watercourse 14, the eastern extent of wetland 59, and wetland 61. At the southern extent of the mine footprint PA, alteration to wetland 29 has the potential to indirectly impact lower lying portions of the same wetland system, as it extends beyond the southern mine footprint PA boundary.

Potential also exists for up-gradient hydrological alteration as a result of downgradient hydrological alteration. Examples include altered outflow (i.e., faster or slower outflows due to mine site drainage infrastructure), causing either dewatering (drying hydrological trend) or flooding conditions in up-gradient wetlands. Locations within the mine footprint PA where this is considered a possibility include southern extents of wetland 2 and southern portions of wetland 57.

The potential for indirect wetland impacts as a result of upgrading and new construction of the proposed Haul Road also exists. However, due to the limited alteration footprint to up-gradient wetlands from Haul Road infrastructure and standard road construction mitigation methods that will be employed as part of the construction process, downgradient, indirect impacts are not expected. As is consistent with alteration to all wetlands associated with the Project, protection and viability of connected, unaltered areas of wetland habitat are considered as part of the provincial wetland alteration process. Design of suitable hydrological connectivity structures (e.g., culverts), the implementation of a Project EPP, and ESC methods will be employed to ensure that indirect impacts to upstream or downstream wetlands will not occur as a result of the activities associated with the Haul Road. In addition, however, post construction monitoring will be performed at alteration locations as discussed in Section 6.5.7 to ensure this expectation.

Furthermore, as part of the design process associated with the new Haul Road, the proponent has committed to identifying culverts that are currently in disrepair (i.e., are not effectively maintaining wetland hydrological connection) and removing them where appropriate. This will remove hydrological connectivity barriers and, in combination with the installation of culverts along the new alignment, will improve natural wetland characteristics.

As discussed in Section 6.5.7.1, a comprehensive wetland monitoring program will be developed to meet the requirements of wetland alteration permits issued for direct and indirect wetland alterations associated with the Project.

6.5.6.4 Wetland Avoidance

Due to the location in which the proposed activity can be performed (the location of the gold ore is fixed by geology), the extent to which the proposed Project can be manoeuvred to avoid impact to wetland habitat is limited. The waste rock storage pile location has been relocated west to avoid the large headwater wetlands 1 and 2. Stockpile locations have been placed to reduce wetland impact and may still be able to be micro-sighted to limit or reduce wetland alteration. Infrastructure has been placed to limit potential direct and indirect impact to Crusher Lake, Mud Lake, and its associated watercourse 5 that drains from Crusher Lake to Mud Lake.

The preliminary haul road design has been based on following the existing footprint of the Beaver Dam Mines Road and the Moose River Cross Road to reduce overall wetland impact and habitat fragmentation. Where new road construction is required to improve sight lines and/or turning radii, landscape conditions (e.g., topography) are the driving factor in the new Haul Road footprint. However, wetland avoidance is a key consideration during planning and engineering of new sections of road, where possible. One section of new road is planned (Figure 2.2-2). Wetland avoidance, landscape conditions, locations of watercourses, sight lines, and safety, will be key planning factors during the detailed engineering for this road.

It has been determined that one wetland (WL29) exists as WSS as a result of the presence of the Boreal Felt Lichen. The predictive NSE WSS database indicates that WL64 also exists as a WSS due to it comprising possible nesting or breeding for the Olive-sided Flycatcher. Both WSS polygons fall within the PA. The Boreal Felt Lichen observed during field surveys is located in an extent of WL29 that exists beyond the southern PA boundary, and as such is not expected to be impacted as a result of Project activities. No evidence of nesting/breeding Olive-sided Flycatcher was observed within WL64 during breeding bird surveys completed within the wetland by MEL. In addition, four additional SAR birds were identified within or adjacent to fifteen (15) other wetlands within the PA (30 m). Suitable breeding habitat is present for two of the species (Olive-sided Flycatcher and Canada Warbler) within twelve (12) of the 15 wetlands.

Regulatory consultation should be completed to determine whether WL64 and any of the additional 12 wetlands are classified as a WSS.

The wetlands within the PA do not contain other critical wetland functions that warrant avoidance (e.g., significant fish habitat, presence of critical wildlife habitat, groundwater recharge ability, etc.).

Efforts will be made during the final design process to avoid as much wetland habitat as possible. Infrastructure that may offer more flexibility in this regard includes the detailed design of the Haul Road upgrade alignment, mine site access roads, water diversion channels, settling ponds, and stockpile areas. Details associated with micro-sighting and final wetland alteration requirements will be confirmed at the wetland alteration permitting stage of this Project.

6.5.7 Mitigation and Monitoring

In order to mitigate and reduce overall loss of function of wetland habitat, the actions provided in Table 6.5-14 will be implemented within wetlands where direct impacts and potential indirect impacts to wetland habitat are expected. Mitigation methods are provided for the pre-construction and construction/operation[1] phases of the Project to support mine and Haul Road development.

In addition, the proponent is committed to engaging in wetland compensation activities for the wetland loss associated with the Project as required by the provincial wetland alteration process. A Wetland Compensation Plan will be developed and submitted to NSE with the goal of providing a final plan prior to receiving wetland alteration approval. This plan will include the following options for compensation, prepared in consultation with CWS and NSE:

- On-the-ground restoration opportunities to meet a minimum of 1:1 ratio and to be completed in a watershed near the Project area to the extent possible;
- Other secondary forms of compensation that CWS and NSE consider valuable to support the wetland conservation program in Nova Scotia; and
- Collaboration with local community groups and the Mi’kmaq of Nova Scotia to the extent possible.

[1] *Due to similarities between the construction and operation phases, mitigation methods outlined in Table 6.5-12 have been done so in combination with each other.*

Table 6.5-14 Direct and In-Direct Wetland Impact Mitigation

Mitigation Type	Details	Direct Impacts	In-Direct Impacts
	PRE-CONSTRUCTION		
Wetland Awareness	- Complete pre-construction site meetings with relevant construction staff to educate staff on the locations of wetlands and policies related to working around wetlands and watercourses; - Identify and communicate schedule of construction activities as it relates to alteration of wetland habitat; - Provide copies of relevant maps and digital format locations of wetlands as well as approvals and terms and conditions that pertain to wetlands to the contractor; - Ensure wetland boundary flagging tape is in place prior to construction activities taking place; - Ensure all development related activity (e.g., construction areas, access roads) are located within areas where biophysical field evaluations have been completed and approvals/written authorizations are in place as required, including work within 30 m of a wetland or watercourse; and, - Machinery and personnel will be instructed not to enter the wetland outside of approved alteration area.	Y	Y – to prevent unnecessary impact to unaltered wetlands
Sediment and Erosion Control Ensure all sediment and erosion control methods are in place. Methods specifically relevant to working in proximity to wetlands including	Management of silt laden water through use of silt fencing, on-site drainage control, and settling ponds.	Y	Y – to prevent silt entering unaltered wetlands
	Maintain existing vegetation cover whenever possible and minimize overall areas of disturbance. Ensure contractors minimize travel across areas of exposed soils. Maintaining existing vegetation cover is the best and most cost-effective erosion control practice.	Y	Y – to prevent erosion in unaltered wetlands
	Manage construction and roadway runoff through natural vegetation.	Y	Y – to prevent runoff into unaltered wetlands
	Use of clean, non-ore-bearing, non-watercourse derived, and non-toxic materials for erosion control methods.	Y	Y – to mitigate downgradient impacts
	Implement all erosion and sediment control structures prior to any soil disturbing activities, when applicable.	Y	Y – to mitigate downgradient impacts

Table 6.5-14 Direct and In-Direct Wetland Impact Mitigation

Mitigation Type	Details	Direct Impacts	In-Direct Impacts
	Drainage structures will be incorporated, where necessary, to dissipate hydraulic energy and maintain flow velocities sufficiently low to prevent erosion of native soil material.	Y	Y – to mitigate downgradient impacts
	Avoid frequent or unnecessary travel over erosion prone areas through communication with personnel and project planning.	Y	Y – to mitigate downgradient impacts
	Erosion and sediment control planning will be completed to ensure site runoff is not directed towards a partially impacted wetland.	Y	N
	Construction methods will consider techniques to reduce the potential to drain or flood a partially altered wetland or downgradient wetland via indirectly altered hydrology due to mine development, site dewatering, or road construction.	Y – partially altered wetlands	Y – to mitigate downgradient impacts
Accidents and Malfunctions	In order to protect wetland habitat from accidental spills, ensure that the spill control and contingency planning is in effect and its procedures fully communicated to staff.	Y	Y – to mitigate downgradient impacts
Monitoring (see additional information in Section 6.5.7.1	Complete baseline monitoring measurements and observations prior to wetland alteration activities taking place so that comparisons with post alteration conditions can be ascertained.	Y – partially altered wetlands	Y – in downgradient wetlands subject to potential indirect alteration
	Communicate with contractor and Project staff the location of monitoring stations within remaining wetland habitat that is not approved for alteration.	Y – partially altered wetlands	N
Vegetation Management	Limit clearing within wetland habitat outside of approved wetland alteration areas.	N	Y
	Vegetation management in or near wetlands will be conducted by cutting (i.e., no use of herbicides).	Y	Y

Table 6.5-14 Direct and In-Direct Wetland Impact Mitigation

Mitigation Type	Details	Direct Impacts	In-Direct Impacts
	The slope between the edge of the mine infrastructure, roads or stockpile locations, or ditch and adjacent wetlands will be re-vegetated to stabilize the slope and limit erosion and sedimentation into each adjacent wetland.	Y – partially altered wetlands	Y – to mitigate potential impact to unaltered wetlands
Water Management	Maintenance of pre-construction hydrological flows into and out of downstream wetland habitats and partially altered wetlands, to the extent possible (post alteration wetland monitoring maybe required as a result of provincial permitting process).	Y – partially altered wetlands	Y – to mitigate downgradient impacts
Wetland Avoidance and Permitting	Wetlands will be avoided wherever possible during detailed Project planning and design.	Y	N
	Where wetlands cannot be avoided, minimization of total Project footprint within the wetland will be considered during planning.	Y	N
	A wetland alteration application will be submitted during Project planning and design to request an authorization to alter wetland habitat. Loss of function will be addressed in this wetland alteration application, as will mitigation and monitoring details. Detailed monitoring and compensation plans will be provided at this time.	Y	Y – only if indirect downgradient wetlands are expected to be altered
	Compensation for permanent loss of wetland function will be completed through wetland restoration activities to support no net loss of wetland function, subject to NSE approval.	Y	Y – only if indirect downgradient wetlands are expected to be altered
CONSTRUCTION / OPERATION PHASE			
Wetland Awareness	Construction crews will adhere to wetland alteration and general construction schedules.	Y	N
	All work associated with wetland alterations will have site-specific terms and conditions in the approval which must be followed.	Y	N

Table 6.5-14 Direct and In-Direct Wetland Impact Mitigation

Mitigation Type	Details	Direct Impacts	In-Direct Impacts
	Ensure all development related activity (e.g., construction areas, access roads) are located within areas where biophysical field evaluations have been completed and approvals/written authorizations are in place as required, including work within 30 m of a wetland or watercourse.	Y	Y – to mitigate impacts to unaltered wetlands
Best Management Practices	For wetlands where infilling has been approved, limit to infill with materials permitted for use as documented within applicable approval documents.	Y	N
	Maintenance of the sediment and erosion control mitigations in place prior to each new phase of construction.	Y	Y – to mitigate impacts to unaltered wetlands
	Limit driving and use of machinery within wetland habitat where practical with use of swamp mats/corduroy bridges in wet areas to prevent rutting, diverting water flow, and sedimentation.	Y	N – no use of machinery will be permitted in unaltered wetlands
Accidents and Malfunctions	Ensure proper fuel management by establishing and implementing spill management and contingency planning including use of staging areas for fueling a minimum of 30 m from wetland and watercourse locations and site signage to increase awareness.	Y	Y – to mitigate impacts to unaltered wetlands
	Implement site speed limits, including signage to increase awareness for personnel.	Y	Y – to mitigate impacts to unaltered wetlands
Vegetation Management	Maintain riparian wetland and watercourse buffers (where practical) to reduce adverse effects to wetlands, watercourses, and downstream receiving environments by clearly defining the limits of work.	Y	Y – to mitigate downgradient impacts
	Clearing of vegetation within wetlands should occur outside of the breeding bird window where possible; otherwise nesting surveys must be completed to ensure compliance with federal legislation.	Y	N – no clearing will occur in unaltered wetlands
Monitoring	Complete regular observations by to ensure protective measures are being implemented	Y	Y

Table 6.5-14 Direct and In-Direct Wetland Impact Mitigation

Mitigation Type	Details	Direct Impacts	In-Direct Impacts
	DECOMMISSIONING		
Water Management	Structures and methods to manage surface water within the PA (e.g., culverts, diversion channels, settling ponds) either will be removed or will remain in position. Structures left in place post-decommissioning will be evaluated for their effectiveness at maintaining hydrological conditions such that existing wetland habitat is preserved. Should structures be removed, an evaluation of potential impact to existing wetlands will be completed and necessary mitigation steps will be implemented.	Y	Y
Vegetation	Upon final abandonment, areas that have erosion potential may be straw crimped and/or matted and seeded to return the area to pre-disturbance conditions in a timely fashion.	Y	Y
Monitoring	Monitoring of existing wetlands to evaluate their condition and integrity may be necessary during the post-decommissioning phase. This will ensure impacts to wetlands have not occurred as a result of decommissioning activities (e.g., water management structure removal).	Y	Y – to mitigate impacts to downgradient wetlands

6.5.7.1 Monitoring

A comprehensive wetland monitoring program will be developed to meet the requirements of wetland alteration permits issued for direct wetland alterations associated with the Project. As previously discussed, proposed Project design involves the complete alteration of 35 wetlands and partial alteration of 79 wetlands as a result of Project infrastructure within the mine footprint and upgrades and new construction for the Haul Road.

The wetland monitoring plan will consider all remaining wetland habitat associated with partially altered locations and also potential for indirect impacts to the remaining wetland habitats outlined in Table 6.5-13. In addition, consideration will be afforded to wetlands that exist in the LAA which are not being directly impacted by Project activities, but have the potential to be impacted by altered upstream (or downstream) hydrological conditions. Notably, larger receiving features which act as receptors from wetlands and watercourses being altered as part of the Project will be a focus. The proponent will monitor these areas to determine whether these wetland areas remain intact and maintain their natural characteristics and integrity after alteration of permitted wetlands. Wetland monitoring will likely be coordinated with other monitoring programs required for the Project, such as surface water quality monitoring and/or water withdrawal monitoring. The wetland monitoring program will include the following criteria:

- Wetland Hydrology: baseline hydrological conditions within planned partially altered wetlands and wetlands located downgradient of alteration locations (including beyond the PA boundary that fall within the LAA) will be evaluated prior to construction activities. Techniques will range from installation of shallow monitoring wells in combination with automated water level recording equipment to visual qualitative observations of hydrological conditions within remaining wetland habitat in the PA. Post-construction monitoring will be compared to baseline conditions to evaluate potential impacts to remaining wetland habitats.
- Wetland Vegetation: baseline vegetative conditions will be evaluated and compared with post-construction conditions. Techniques will range from the completion of specified vegetation transects and plots to visual qualitative observations.
- Water Quality: in combination with other monitoring requirements associated with the Project, water quality will be monitored in downgradient aquatic receptors to ensure that up-gradient activities are not compromising water quality conditions.
- Other direct and indirect impacts: general observations will be completed during the construction phase and post-construction phase to determine whether partially altered wetlands or unaltered adjacent and downgradient wetlands are subject to other direct or indirect impacts. Impacts could include disturbances to wetland surfaces (e.g., rutting, heaving), improper vegetation management, improper access of construction vehicles, sedimentation and erosion, and unplanned changes in hydrological inflow and outflow (e.g., damming, de-watering, disturbance to natural swales and drainage corridors).

Implementation of the strategies discussed above will support the mitigation process associated with wetland protection. A final wetland monitoring plan will be developed prior to construction in conjunction with wetland alteration permitting. The plan will be refined in order to meet the specific activities and timing of activities within the PA.

6.5.8 Residual Effects and Significance

The predicted residual environmental effects of Project development and production on wetlands are assessed to be adverse, but not significant. The overall residual effect of the Project on wetlands is assessed as not significant after mitigation measures have been implemented and short time frame for Project considered.

Table 6.5-15 Residual Environmental Effects for Wetlands

Project VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Significance Criteria for Residual Environmental Effects						Residual Effect	Significance
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
Clearing and grubbing (reduced infiltration, introduction of invasives)	Sediment and erosion control, reclamation during decommissioning and best management practices. (See mitigation: Table 6.5-13)	A	L	PA	LT	R	R	LD	Habitat Loss	Not Significant
Heavy machinery operation (impacts to water quality from dust, sediments, accidents and contamination)	Sediment and erosion control, spill preparedness and best management practices (See mitigation: Table 6.5-13)	A	M	PA	ST	R	R	LD	Disturbance	Not Significant
Direct wetland alteration (infilling, draining, flooding, altering function, altering groundwater recharge capacity)	Engage wetland permitting process Wetland monitoring and compensation See mitigation: Table 6.5-13	A	M	PA	P	O	IR	LD	Habitat Loss Disturbance	Not Significant
In-direct wetland alteration (water quality, hydrological imbalance, sedimentation)	Wetland monitoring and compensation See mitigation: Table 6.5-13	A	L	LAA	MT	S	R	LD	Disturbance	Not Significant
Widening and new haul road construction (hydrological changes, wetland alteration and vegetation removal)	Engage wetland permitting process Wetland monitoring See mitigation: Table 6.5-13	A	L	PA	P	O	IR	LD	Habitat Loss Disturbance	Not Significant

Table 6.5-15 Residual Environmental Effects for Wetlands

Project VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Significance Criteria for Residual Environmental Effects						Residual Effect	Significance
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
Blasting (once per week) and drilling of in-situ rock	Pre-blasting plan and evaluation of potential to indirectly impact wetland habitat.	A	L	PA	ST	R	R	LD	Disturbance	Not Significant

Legend (refer to Table 5.10-1 for definitions)

Nature of Effect		Geographic Extent		Frequency		Ecological and Social Context	
A	Adverse	PA	Project Area	O	Once	LD	Low Disturbance
P	Positive	LAA	Local Assessment Area	S	Sporadic	MD	Moderate Disturbance
		RAA	Regional Assessment Area	R	Regular	HD	High Disturbance
Magnitude				C	Continuous		
N	Negligible	**Duration**					
L	Low	ST	Short-Term	**Reversibility**			
M	Moderate	MT	Medium-Term	R	Reversible		
H	High	LT	Long-Term	IR	Irreversible		
		P	Permanent				

6.5.9 Proposed Compliance and Effects Monitoring Program

As the Project moves forward, monitoring programs will proceed to gather pre-construction wetlands baseline data. Monitoring programs will continue during construction, operation, and post-production to verify baseline conditions and to determine the effects of the Project on the wetlands in the PA and LAA. Table 6.5-14 summarizes the mitigation and monitoring activities that will be completed throughout the life of the Project. The proponent is committed to engaging in wetland compensation activities for the wetland loss associated with the Project as required by the provincial wetland alteration process. A Wetland Compensation Plan will be developed and submitted to NSE with the goal of providing a final plan, prior to receiving wetland alteration approval.

A comprehensive wetland monitoring program will be developed to meet the requirements of wetland alteration permits issued for direct wetland alterations associated with the Project.

The details of the monitoring programs will be determined in consultation with regulatory agencies and will be described in the application for an IA for the site operations following the EA process. High level detail is needed in this application and would be subject to review by NSE and other agencies. An EMS and EPP will be developed as part of the Project implementation that will confirm the responsibility and system of accountability for the compliance and effects monitoring program.

Wetland monitoring programs will include the following, as well as additional monitoring as determined through discussions with regulatory agencies:

- Baseline hydrological conditions prior to construction activities;
- Baseline vegetative conditions will be evaluated and compared with post construction conditions;
- In combination with other monitoring requirements associated with the Project, water quality will be monitored in down-gradient aquatics receptors to ensure that up-gradient activities are not compromising water quality conditions; and
- General observations will be completed during the construction phase and post construction phase.

The frequency and location of wetland monitoring will be described in greater detail in the EPP following consultation with regulatory agencies.

6.6 Fish and Fish Habitat

6.6.1 Rationale for Valued Component Selection

This section summarizes the methods used during evaluation of fish and fish habitat conducted by MEL biologists at waterbodies, wetlands, and linear watercourses identified as being potentially fish bearing throughout the PA. Linear watercourses were identified and described across the mine footprint PA (summer 2015) and the haul road footprint PA (spring 2016), and three waterbodies within the mine footprint (Crusher Lake, Mud Lake, and Cameron Flowage) were described for physical parameters in the summer of 2015. Wetland delineation and evaluation were completed in 2015 (mine footprint PA) and 2016 (haul road PA). Each of these systems was evaluated for the presence of fish habitat and potential ability to support fish species during initial assessment and identification. Once this was completed, fishing locations and methods were determined within reaches of linear watercourses where fish potential was higher, and within identified waterbodies, and a variety of fishing surveys were completed.

Field assessments to complete electrofishing and supporting fish collection were conducted on September 17-18, 2015 within the mine footprint PA's linear watercourses. Additional field assessments were also completed between June 20-27, 2016 within linear watercourses within the haul road PA and two waterbodies within the mine footprint PA. Fishing surveys included: detailed fish habitat assessment surveys; electrofishing within linear watercourse reaches; fish collection within linear watercourses and waterbodies; water quality surveys; and aquatic ecosystem condition benthic surveys (Canadian Aquatic Biomonitoring Network (CABIN) protocol, [Environment Canada, 2012]). The method for each fishing survey is described in detail below.

6.6.2 Baseline Program Methodology

Fish habitat characterization was completed for each linear watercourse, wetland, and waterbody identified within the PA. The methods to complete habitat characterization were adopted from the *Standard Methods Guide for Freshwater Fish and Fish Habitat Surveys in Newfoundland and Labrador: Rivers and Streams* (Sooley et al., 1998). Further to this initial characterization, a detailed fish habitat survey was also completed at each 100 m length electrofishing site, including the identification of physical units (i.e., run, riffle, or pool), designation of substrate type, and depth and width (wetted and bankfull) of the linear section of the watercourse. The presence or absence of over-head cover, undercut banks, and woody debris was also recorded since these habitat features affect the ability of the watercourse and associated wetland habitat to support fish communities.

As described in the *Standard Methods Guide for Freshwater Fish and Fish Habitat Surveys in Newfoundland and Labrador: Rivers and Streams*, water quality and quantity tolerances of the Atlantic salmon (*Salmo salar*) were used as an index of the relative health of the river for fish populations. The Atlantic salmon was chosen as an indicator species for several reasons (Sooley et al., 1998):

- Salmon inhabit areas targeted for the assessments (riffle and pool habitat);
- Salmon are sensitive to acidification;
- Salmon are a predatory species at the top of the food chain; and
- Data exists that defines preferred habitat conditions for this species.

6.6.2.1 Electrofishing

Sampling sites of approximately 100 m in length were selected as representative habitats with high potential to support fish along a section of a watercourse within each tertiary watershed throughout the haul road PA and across watercourses identified within the mine footprint PA. The purpose of the electrofishing surveys was to determine what species of fish are present within watercourses and associated wetlands within the PA and to estimate population. Fifteen electrofishing sites were selected; eight within the mine footprint PA and seven within the haul road PA. These locations are shown on Figures 6.3-3 and 6.3-3A to 6.3-3L. Fishing was completed under Fisheries and Oceans Canada Fishing License # 341208.

Standardized data collection forms developed by the New Brunswick (NB) Aquatic Resources Data Warehouse, the NB Department of Natural Resources and Energy, and the NB Wildlife Council (2002, updated 2006) were adapted for use for field data collection during electrofishing surveys. Field data collected included the physical and chemical parameters of the electrofishing site, along with electrofishing methods and settings, and results of electrofishing surveys.

Prior to sampling, each site was blocked off with barrier nets (1/8" mesh) that were secured to the streambed at either end of the 100 m linear reach of watercourse in order to prevent the loss of stunned or frightened fish. Barrier nets have a floating top line, and were anchored to the shoreline with rebar or rocks and to the substrate with rocks. The Electrofishing Site Form (NB Aquatic Resources Data Warehouse, NB Department of Natural Resources and Energy, NB Wildlife Council, 2002, updated 2006) was completed to identify and describe the physical and chemical characteristics of the reach to be sampled. This site description helped the electrofishing crew determine the appropriate settings on the electrofishing unit based on physical parameters of the watercourse, conductivity, and species expected to be present. Survey effort (in electrofishing seconds) was recorded on the Electrofishing Site Form as well. Water quality measurements were recorded in the field with a Horiba U22 Multi-parameter probe or YSI 650 MDS & 600 QS Multi-Probe.

Fisheries and Oceans Canada's Interim Policy for the Use of Backpack Electrofishing Units (2003) was reviewed and followed by all members of the electrofishing crew. This document provides a detailed list of standard equipment, safety, training, and emergency response procedure requirements for electrofishing. Each electrofishing crew consisted of two individuals, one of which (the crew lead) was a qualified person as defined under the DFO Interim Electrofishing Policy. The crew lead is responsible for operating the backpack electrofisher according to their training and the Policy, and for communicating safety policies and electrofishing procedures to the second crew member.

Fish were sampled within the isolated sampling areas using a Halltech Battery Backpack Electrofisher (HT-2000) with unpulsed direct current (DC) and a single pass or double pass depending on the location. The operator waded upstream to eliminate the effects of turbidity caused by bottom sediment and probed the anode into likely fish habitat within the site. A second crew member walked ahead of the operator to net any stunned fish using a D-frame landing net (1/8" mesh). All captured fish were held in a live well containing ambient stream water, which was kept out of the sun and checked regularly. At the conclusion of each pass, fish in the live well were identified (species confirmation) and measured (total length in mm). Status, sex, and maturity were also recorded for individual fish using the Individual Fish Measurement Form (NB Aquatic Resources Data Warehouse, NB Department of Natural Resources and Energy, NB Wildlife Council, 2002, updated 2006). After recuperating, all fish were released upstream and outside of the sampling site.

6.6.2.2 Fish Collection and Characterization

Two representative survey locations, site A and site B, within Cameron Flowage and Crusher Lake were chosen to complete fish collection within the mine footprint PA. Fish collection was completed in 2016 to support and supplement electrofishing efforts completed in 2015 within linear watercourses in the mine footprint PA. At each lentic sampling location, MEL biologists placed a fyke net, eel pot, and two minnow traps to capture and record fish presence to support fish species identification and relative abundance of fish species present. Fyke nets were placed in the shallow inshore littoral zone at sites A and B within Crusher Lake and Cameron Flowage. The fyke nets were fixed in place by stakes driven into the substrate of the waterbody through each wing of the net. Eel pots were also placed near the fyke nets within the littoral shelf of the two waterbodies to support fish collection within the PA. These eel pots were baited with cat food. Finally, two minnow traps were also placed and baited with cat food at each location to further support the collection of smaller fish and aid in species identification within the PA.

MEL biologists also placed minnow traps along the linear watercourses in deeper pools within the haul road PA during electrofishing surveys in 2016 to support the collection and identification of smaller fish in locations where electrofishing was not possible to due water depth.

Details of the fish collection locations, survey dates, and times are provided in Table 6.6-1.

Table 6.6-1 Fish Collection Locations and Details

Fish Collection Location	Fish Collection Methodology	Survey Location Coordinates		Survey Date	Survey Time	Tertiary Watershed
		Easting	Northing			
Crusher Lake A	Fyke Net	521617	4990137	June 27, 2016	4hr 26mins	Cameron Flowage
	Eel Pot	521579	4990165		4hr 44mins	
	Minnow trap 1	521577	4990161		4hr 26mins	
	Minnow trap 2	521573	4990171		4hr 25mins	
Crusher Lake B	Fyke Net	521566	4990193	June 27, 2016	4hr 25mins	Cameron Flowage
	Eel Pot	521563	4990196		4hr 23mins	
	Minnow trap 1	521563	4990186		4hr 23mins	
	Minnow trap 2	521569	4990189		4hr 23mins	
Cameron Flowage A	Fyke Net	522708	4990370	June 24, 2016	4hr 55mins	Cameron Flowage
	Eel Pot	522708	4990378		4hr 17mins	
	Minnow trap 1	522718	4990368		4hr 58mins	

Table 6.6-1 Fish Collection Locations and Details

Fish Collection Location	Fish Collection Methodology	Survey Location Coordinates		Survey Date	Survey Time	Tertiary Watershed
		Easting	Northing			
	Minnow trap 2	522705	4990365		4hr 11mins	
Cameron Flowage B	Fyke Net	522743	4990338	June 24, 2016	5hr 08mins	Cameron Flowage
	Eel Pot	522728	4990345		4hr 52mins	
	Minnow trap 1	522753	4990318		5hr 05mins	
	Minnow trap 2	522729	4990352		5hr 08mins	
Electrofishing 1 Haul Road (Crossing B)	Minnow trap 1	522691	4988578	June 20, 2016	2hr 18mins	Tent Lake
	Minnow trap 2	522697	4988568		2hr 18mins	
	Minnow trap 3	522700	4988555		2hr 17mins	
Electrofishing 3 Haul Road (Crossing N)	Minnow trap 1	521856	4983929	June 22, 2016	2hr 02mins	Brandon Lake/Rocky Brook Lake
	Minnow trap 2	521867	4983925		2hr 07mins	
	Minnow trap 3	521877	4983920		2hr 11mins	
Electrofishing 5 Haul Road (Crossing V)	Minnow trap 1	517417	4982555	June 16, 2016	2hr 25mins	Lake Alma
	Minnow trap 2	517429	4982564		2hr 26mins	

Note: Minnow traps were not utilized in Electrofishing 2, 4, 6, and 7 survey locations along the haul road due to low water depths.

All captured fish were held in a live well containing ambient lake water, which was kept out of the sun and checked regularly. Fish in the live well were identified to species and measured (total length in mm). After recuperating, all fish were released into the waterbody and outside of the sampling site.

The suite of survey methods (detailed habitat surveys, electrofishing, and fish collection with eel pots, fyke nets, and/or minnow traps) was selected based on ability to identify the breadth of species diversity present throughout various habitat types available in the PA.

Fish population characterization was completed through two mechanisms, the two pass depletion population estimate and the catch per unit of effort (CPUE), depending on the location of sampling and method of fish collection (e.g., electrofishing, netting).

Two-Pass Depletion Population Estimate

Two passes of electrofishing occurred within 100 m stretches of the watercourses within the haul road PA. The fish were recorded by species and counted separately per pass and by watercourse. For all electrofishing locations within the haul road PA, the two-pass depletion method was used to estimate population size of fish species found in the sampled watercourses. This depletion method can be used when the stream is very small, it is expedient to collect all data within a short time period, such as one day, and the population being estimated is relatively small (roughly less than 2,000 individuals (Lockwood and Schneider, 2000). Using this data, population estimate and variance of population estimated was calculated. The formulas (Heimbuch et al., 1997) are provided below:

Population estimate $N = C_1^2/(C_1 - C_2)$
Variance of $N = C_1^2 C_2^2 (C_1 + C_2)/(C_1 - C_2)^4$
Standard error of $N = \sqrt{\text{Variance of } N}$

N=*Population estimate*
C_1=*number of fish removed in first pass*
C_2=*number of fish removed in second pass*

CPUE is usually assumed to be proportional to abundance and therefore included in stock assessment as a relative index of abundance. CPUE expresses how many fish (all species) are caught by a unit of effort (Hinton and Maunder, 2003). CPUE was calculated for each fish collection net (fyke, minnow trap, eel pot) deployed in Cameron Flowage and Crusher Lake in 2016. CPUE was also calculated for the one-pass electrofishing methodology completed within the mine footprint PA in 2015.

CPUE=Catch (fish)/Effort (time in hours)

The catch consists of how many fish were caught in a certain piece of fishing equipment. In the field, each fish was recorded and counted. The effort consists of the wetted time, which is equivalent to the time each piece of equipment was present in the waterbody. The start time and the end time were recorded for each piece of fishing equipment as they were placed and removed from the waterbody (Hinton and Maunder, 2003).

6.6.2.3 Water quality

Water quality was measured at each representative linear section of watercourses chosen for electrofishing within the mine footprint PA (September 2015) and the haul road PA (June 2016) (15 locations). Water quality measurements were also collected from Crusher Lake and Cameron Flowage during fish collection surveys. All water quality measurements were collected using a Horiba multi-probe (W-22XD) or YSI 650 MDS & 600 QS Multi-Probe water quality instrument. Parameters recorded include dissolved oxygen (mg/L), water temperature (°C), pH, and specific water conductivity (S/m).

6.6.2.4 Aquatic Ecosystem Condition

Benthic macroinvertebrate sampling was completed using the national standardized CABIN protocol (Environment Canada, 2012). Benthic sampling was completed at each electrofishing reach in watercourses within the haul road PA and at three locations within the mine footprint PA where confirmed fish presence was known. Benthic sampling was completed to support fish habitat evaluation as a baseline measurement, as biological parameters may detect impacts to the aquatic ecosystem that the physical and chemical parameters cannot, such as changes in water quantity, presence of invasive species, and habitat degradation. Benthic macroinvertebrates are common inhabitants of streams and lakes and are important in moving energy through food webs. Benthic macroinvertebrates are relatively long-lived (one to three years) and, therefore, can reflect cumulative impacts to aquatic ecosystem.

A site description, water chemistry, substrate characteristics, and channel measurements were recorded at each sampling location. The traveling kick net method was used to sample for macroinvertebrates. Using a 400 µm mesh kick net, the sampler shuffled upstream in a zigzag pattern for the standardized sampling effort (three minutes). The sample was then transferred to the sample jars and preserved with a 70% isopropanol solution. The samples were recorded, labeled, and sent to Envirosphere Consultants Ltd. for analysis.

MEL provided ten 'kick net (d-net)' samples to Envirosphere Consultants Ltd. in Windsor, Nova Scotia on July 7, 2016 for biological analysis (identification and assessment for biological species composition and abundance). The ten samples (14 x 250 ml) contained organisms in preservative collected from each electrofishing reach within linear watercourses within the haul road PA (7 in total) from June 22-24, 2016 and from three selected locations within linear watercourses connected to Cameron Flowage and Crusher Lake in the mine footprint PA. Two locations within the haul road PA (watercourse A and Watercourse AH) required multiple bottles to collect samples (14 sample jars from 10 locations were transported for analysis).

Laboratory Methods: Sub-Sampling

Prior to sorting, samples and sub-samples were rinsed on a 0.5 mm 20 cm diameter circular sieve to remove preservative. To ensure a reasonable processing time, three of the fourteen samples were then sub-sampled at 50% or 75% to ensure processing efficiency. Sub-sampling involved dividing the sample in four, by weight. The sample was spread evenly in the sieve and divided into fourths, with quarters transferred in their entirety into plastic trays. The trays with contents were weighed and verified to be within 0.5 to 1.0 g of each other to ensure even distribution of the material. Two or three of the four trays were randomly selected for sorting and identification and the others held until the final sample analysis was completed to allow an opportunity for further analysis if necessary to ensure adequate counts for interpretation. Final counts and biomass for the sub-samples were extrapolated to 100% based on the sub-sample percentage (i.e., 50%). Sub-sampling can affect measures of animal abundance and biomass by increasing variability and may lead to slightly reduced estimates of taxon richness compared to whole samples.

Sorting and Identification

Samples and sub-samples were examined at 6 to 6.4 times magnification on a stereomicroscope, with a final brief check at 16 times magnification. Organisms were removed and subsequently stored in labeled vials in 70% isopropyl alcohol. Sorting efficiency for lab personnel is checked periodically by re-sorting samples to ensure average recovery levels of 90% or better. Wet weight biomass (grams per sample) was estimated for each sample by weighing animals to the nearest milligram at the time of sorting and after blotting to remove surface water.

Organisms were identified to an appropriate taxonomic level, typically to genus, using conventional literature for the groups involved. Organisms were identified by Valerie Kendall (M.Env.Sc.) and verified by Heather Levy (B.Sc. Honours) of Envirosphere Consultants Ltd. Sorting of animals from the samples, identification, total number of animals of each type (taxonomic group), as well as total abundance, were determined for each sample. These numbers were used to calculate several indices of benthic community health, which can be compared between sites and, with time, at each site (an index of community health is like a body mass index or an IQ, which gives a single number that can be used to compare individuals or things). Indices calculated are all commonly used in studies of this kind and include: EPT Ratio (ratio of abundance of mayflies (Ephemeroptera), caddisflies (Trichoptera), and stoneflies (Plecoptera), to total numbers of organisms); Total Abundance (number of animals in the sample and per unit area); and Taxon Richness (number of taxa per sample). Abundance in kick net samples was expressed on a per sample basis. All organisms present were included in estimates.

All electrofishing, fish collection, water quality, and benthic sampling locations are shown on Figures 6.3-3 and 6.3-3A to 6.3-3L.

6.6.3 Baseline Conditions

This section describes the results from fish habitat surveys, supporting electrofishing surveys, fish collection, benthic invertebrate sampling, and water quality surveys within the watercourses and associated wetland habitat within the mine footprint and haul road PA. A photographic log of the watercourses and fish habitat encountered in the PA is included as **Appendix H.**

6.6.3.1 Fish Habitat Assessment

The potential for each watercourse and wetland to support fish habitat and fish was evaluated across the PA. As identified in Section 6.5, 34 linear watercourses were identified within the haul road PA and 14 linear watercourses were identified within the mine footprint PA. Three waterbodies were identified within the mine footprint PA (Crusher Lake, Mud Lake, and Cameron Flowage), all of which were expected to support fish. No waterbodies were identified within the haul road PA. One hundred and seventy-eight wetlands were evaluated across the mine footprint and haul road PA. Fish habitat potential was determined at each location during field identification/evaluation and collection of physical characteristics of each watercourse/wetland. Detailed fish habitat surveys and supporting electrofishing were completed at seven representative watercourse reaches within the haul road PA (one per tertiary watershed) and also at eight locations within watercourses in the mine footprint PA to understand fish species presence and characterization of fish populations. Based on the physical characteristics of watercourses and waterbodies within the PA, and also based on fish collected during electrofishing and netting surveys, the type and quality of fish habitat has been described.

This qualitative description of fish habitat is based on the *Standard Methods Guide for Freshwater Fish and Fish Habitat Surveys in Newfoundland and Labrador: Rivers and Streams* (Sooley et al., 1998) and the descriptions provided are for fish of the Salmonidae family, using the Atlantic salmon as the indicator species. Descriptions provided in Table 6.6.3 below specifically identify suitable habitats for spawning, rearing, refuge, overwintering, feeding, and passage for Atlantic salmon and brook trout identified within the PA.

Table 6.6-3 describes the fish habitat potential at each identified watercourse within the PA. Fish habitat potential is described based on the categories identified by Beak (1980) and detailed in the NL Guide (Sooley et al., 1998) referenced herein. These classifications are based in some cases on very short sections of watercourses evaluated within the PA only and, therefore, should be considered as preliminary summaries of fish habitat potential, with detailed evaluation necessary during the permitting stages of this Project to confirm fish habitat.

Table 6.6-2 Fish Habitat Descriptions (taken from Beak, 1980)

Type	Fish Habitat Descriptions
I	Good salmonid spawning and rearing habitat, often with some feeding pools for larger age classes: flows: moderate riffles; current: 0.1 - 0.3 m/s; depth: relatively shallow, 0.3 - 1 m; substrate: gravel to small cobble size rock, some larger rocks or boulders; and general habitat types: primarily riffle, pool.
II	Good salmonid rearing habitat with limited spawning, usually only in isolated gravel pockets, good feeding and holding areas for larger fish in deeper pools, pockets, or backwater eddies: flows: heavier riffles to light rapids; current: 0.3-1.0 m/s; depth: variable from 0.3 - 1.5 m; substrate: larger cobble/rubble size rock to boulders and bedrock, some gravel pockets between larger rocks; general habitat types: run, riffle, pocket water, pool.
III	Poor rearing habitat with no spawning capabilities, used for migratory purposes: flows: very fast, turbulent, heavy rapids, chutes, small waterfalls, current: 1 m/s or greater; depth: variable, 0.3 - 1.5 m; substrate: large rock and boulders, bedrock; and general habitat types: run, pocket water, cascades.
IV	Poor juvenile salmonid rearing habitat with no spawning capability, provides shelter and feeding habitat for larger, older salmonids (especially brook trout): flows: sluggish; current: 0.15 m/s; depth: variable but often 1 m; substrate: soft sediment or sand, occasionally large boulders or bedrock, aquatic macrophytes present in many locations; and general habitat types: flat, pool, glide.

Table 6.6-3 Fish Habitat Potential within Linear Watercourses in the Mine Footprint and Haul Road PA

Watercourse	Tertiary Watershed	Easting	Northing	Fish Habitat Type	Habitat Potential
Mine Footprint PA					
1	Tent Lake	522631	4989087	IV	Feeding, Refuge, and Passage
2	Cameron Flowage	522050	4990014	IV	Feeding, Refuge, and Passage
3	Cameron Flowage	522024	4989866	IV	Feeding, Refuge, and Passage
4	Cameron Flowage	521450	4990084	II	Rearing, Feeding, Refuge, and Passage
5 (top near wetland 2)	Cameron Flowage	521808	4989574	IV	Feeding, Refuge, and Passage
5 (lower near wetland 14)	Cameron Flowage	521555	4990209	II	Rearing, Feeding, Refuge, and Passage

Table 6.6-3 Fish Habitat Potential within Linear Watercourses in the Mine Footprint and Haul Road PA

Watercourse	Tertiary Watershed	Easting	Northing	Fish Habitat Type	Habitat Potential
6	Cameron Flowage	521379	4990527	IV	Feeding, Refuge, and Passage
7	Cameron Flowage	521438	4990346	II	Rearing, Feeding, Refuge, and Passage
8	Cameron Flowage	521343	4990272	IV	Feeding, Refuge, and Passage
9	Cameron Flowage	521536	4990206	II	Rearing, Feeding, Refuge, and Passage
10	Kent Lake	521394	4989508	II	Rearing, Feeding, Refuge, and Passage
11	Kent Lake	521166	4989752	IV	Overwintering, Feeding, Refuge, and Passage
12	Cameron Flowage	522202	4990328	II	Feeding, Refuge, and Passage
13	Cameron Flowage	522689	4990224	IV	Feeding, Refuge, and Passage
14	Cameron Flowage	522734	4990027	I	Overwintering, Rearing, Feeding, Refuge, and Passage
Cameron Flowage	Cameron Flowage	522675	4990410	II	Overwintering, Rearing, Feeding, Refuge, and Passage
Mud Lake	Cameron Flowage	521453	4990907	IV	Overwintering, Feeding, Refuge, and Passage
Crusher Lake	Cameron Flowage	521564	4990129	IV	Overwintering, Feeding, Refuge, and Passage
Haul Road PA					
A	Tent Lake	522628	4988891	IV	Feeding, Refuge, and Passage
B	Tent Lake	522705	4988568	II	Rearing, Feeding, Refuge, and Passage
C	Tent Lake	522752	4988169	II	Rearing, Feeding, Refuge, and Passage
D	Tent Lake	522828	4987773	III	Passage
E	Brandon Lake	522907	4987152	I	Spawning, Rearing, Feeding, Refuge, and Passage
F	Brandon Lake	522841	4986566	II	Rearing, Feeding, Refuge, and Passage
G	Brandon Lake	522621	4986085	II	Rearing, Feeding, Refuge, and Passage
H	Brandon Lake	522562	4985938	III	Feeding, Refuge, and Passage

Table 6.6-3 Fish Habitat Potential within Linear Watercourses in the Mine Footprint and Haul Road PA

Watercourse	Tertiary Watershed	Easting	Northing	Fish Habitat Type	Habitat Potential
I	Brandon Lake	522547	4985881	II	Rearing, Feeding, Refuge, and Passage
J	Brandon Lake	522554	4985838	II	Rearing, Feeding, Refuge, and Passage
K	Brandon Lake	522306	4984470	II	Rearing, Feeding, Refuge, and Passage
L	Brandon Lake	522312	4984339	I	Spawning, Rearing, Feeding, Refuge, and Passage
M	Brandon Lake	522234	4984150	II	Rearing, Feeding, Refuge, and Passage
N (West River Sheet Harbour)	Brandon Lake / Rocky Brook Lake	521887	4983922	I	Spawning, Overwintering, Rearing, Feeding, Refuge, and Passage
O	Lake Alma	521193	4983426	IV	Feeding, Refuge, and Passage
P	Lake Alma	520111	4982977	II	Feeding, Refuge, and Passage
Q	Lake Alma	518454	4982878	I	Spawning, Rearing, Feeding, Refuge, and Passage
R	Lake Alma	518335	4982893	IV	Feeding, Refuge, and Passage
S	Lake Alma	518117	4983044	II	Rearing, Feeding, Refuge, and Passage
T	Lake Alma	517873	4982824	II	Rearing, Feeding, Refuge, and Passage
U	Lake Alma	517441	4982674	II	Rearing, Feeding, Refuge, and Passage
V	Lake Alma	517395	4982554	III	Rearing, Feeding, Refuge, and Passage
W	Lake Alma	517500	4982275	IV	Feeding, Refuge, and Passage
X	Lake Alma	517549	4982187	II	Rearing, Feeding, Refuge, and Passage
Y	Lake Alma	517595	4982084	II	Rearing, Feeding, Refuge, and Passage
Z	Lake Alma	517703	4981908	II	Feeding, Refuge, and Passage
AA	Eagles Nest	516527	4979693	II	Rearing, Feeding, Refuge, and Passage
AB	Eagles Nest	516303	4979597	IV	Feeding, Refuge, and Passage

Table 6.6-3 Fish Habitat Potential within Linear Watercourses in the Mine Footprint and Haul Road PA

Watercourse	Tertiary Watershed	Easting	Northing	Fish Habitat Type	Habitat Potential
AC	Eagles Nest	515091	4979240	II	Rearing, Feeding, Refuge, and Passage
AD (Morgan River)	Eagles Nest	514588	4978868	I	Spawning, Overwintering, Rearing, Feeding, Refuge, and Passage
AE	Rocky Lake	514402	4978588	II	Rearing, Feeding, Refuge, and Passage
AF	Rocky Lake	514346	4978527	II	Rearing, Feeding, Refuge, and Passage
AG	Rocky Lake	514286	4978468	III	Feeding, Refuge, and Passage
AH	Rocky Lake	514249	4978518	I	Spawning, Rearing, Feeding, Refuge, and Passage

Eight of the 14 linear watercourses, as described in Table 6.6-3, within the mine footprint PA are classified as poor juvenile salmonid rearing habitat with no spawning capability. These streams would provide shelter and feeding habitat for larger, older salmonids (especially brook trout). Watercourse 4, located south of Crusher Lake, watercourse 5 (lower portion), located north of Crusher Lake, and its tributaries (watercourse 7 and watercourse 9) are all classified as good salmonid rearing habitat with limited spawning, usually only in isolated gravel pockets, good feeding and holding areas for larger fish in deeper pools, pockets, or backwater eddies (Sooley et al., 1998). Watercourse 12, located west of wetland 59 with direct connectivity to Cameron Flowage, also provides good salmonid rearing habitat with limited spawning potential. Watercourse 14, a small watercourse located south of Cameron Flowage, is classified as good salmonid spawning and rearing habitat, often with some feeding pools for larger age classes. However, although substrate and flow meet the requirements for this classification, its small size and average and expected low water depths limit potential for spawning within this tributary.

Mud Lake and Crusher Lake are classified as poor juvenile salmonid rearing habitat based on their sluggish flows, substrate, and depth. These lakes primarily provide shelter and feeding opportunities for larger, older brook trout. Cameron Flowage is classified as good salmonid rearing habitat with some limited potential for spawning. Overwintering could also occur within Cameron Flowage based on observed water depths.

Nineteen of the 34 linear watercourses evaluated within the haul road PA are classified as good salmonid rearing habitat with some limited spawning opportunities. Four watercourses are classified as poor rearing habitat with no spawning potential. Watercourse E, located in the upper reaches of the Brandon Lake Tertiary Watershed on the north side of Cope Pond, is classified as good salmonid spawning and rearing habitat. Watercourse L is also located in the Brandon Lake Tertiary Watershed and is a tributary to the West River Sheet Harbour. This watercourse is also classified as good spawning and rearing habitat. The West River Sheet Harbour (watercourse N) runs through the PA and is known to support all life stages associated with the Salmonidae family, including spawning. Watercourse Q is a tributary that drains directly to Lake Alma in the Lake Alma Tertiary Watershed. Inside the PA, this watercourse was classified as good salmonid rearing and spawning habitat; however, this watercourse was observed to be subterranean downstream within the PA draining towards Lake Alma, which would act as a barrier to fish passage.

The Morgan River (watercourse AD) is located near the south end of the haul road PA in Eagle's Nest Tertiary Watershed. Like the West River Sheet Harbour, the Morgan River is also known to support all life stages of salmonids, including spawning. Its direct tributary, watercourse AH, located in the Rocky Lake Tertiary Watershed, is also good rearing and spawning habitat. The Morgan River is known to support white sucker, brook trout, white perch, yellow perch, banded killifish, rainbow trout, American eel, golden shiner, sticklebacks, alewife, northern redbelly dace, and brown bullhead (Alexander, Kerekes, & Sabean, 1986). The Atlantic Salmon Federation has indicated that the salmon is extirpated from the Tangier Watershed (https://www.asf.ca/main.html).

Table 6.6-4 describes the fish habitat present within each wetland and its associated watercourse in the mine footprint and haul road PA. Wetlands that were determined not to support fish habitat (i.e., no surface water connectivity and/or open water present within the wetland habitat) are not included in this table and are not discussed further in this section. Some throughflow wetlands included in this table only support fish habitat within the watercourse draining through it. If so, this is identified in the table below. Others will support fish habitat both within the watercourse itself and the surrounding wetland habitat.

Table 6.6-4 Fish Habitat Present within Each Wetland and Associated Watercourse

WL ID	Hydrological Regime	Associated Watercourse	Potential Fish habitat	Qualitative Description	Habitat Potential
Mine Footprint PA					
2	Headwater - outflow	WC 5 and WC 3	Fish habitat only within watercourses draining as outflows from this wetland habitat (northern extent of wetland habitat)	Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource
4	Throughflow	WC 2 and WC 3	Fish habitat within standing and open water in wetland	Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource
5	Headwater - outflow	WC 2	Fish habitat only within intermittent watercourse (western extent of wetland habitat)	Seasonal passage	Open Water, Direct connectivity to downstream fish resource
8	Bi-directional non-tidal / Throughflow	WC 4, WC 5, and Crusher Lake	Open water observed in wetland and WC5 throughflow through wetland habitat. Along the southern shore of Crusher Lake	Overwintering, Rearing, Feeding, Refuge and Passage.	Open Water, Direct connectivity to downstream fish resource
10	Lentic – bi-directional - non-tidal	Crusher Lake	Open water and vegetated habitat along lake edge	Overwintering, Rearing, Feeding, Refuge and Passage.	Open Water, Direct connectivity to downstream fish resource
11	Throughflow	WC 4	Fish habitat within standing and open water in wetland	Rearing, Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource
13	Throughflow	WC 4	Fish habitat only within watercourse except in extreme flood events. Currently small beaver dam at outlet causing localized flooding within the wetland	Rearing, Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource

Table 6.6-4 Fish Habitat Present within Each Wetland and Associated Watercourse

WL ID	Hydrological Regime	Associated Watercourse	Potential Fish habitat	Qualitative Description	Habitat Potential
14	Throughflow	WC 3, WC 5, WC 7, and WC 8	Fish habitat only within watercourse except in extreme flood events	Overwintering, Rearing, Feeding, Refuge, and Passage (within wc only)	Open Water, Direct connectivity to downstream fish resource
15	Headwater - outflow	WC 8	Open water observed in wetland with confirmed surface water connections to downstream resources	Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource
17	Lentic – bi-directional - non-tidal/throughflow	WC 5 and Mud Lake	Open water observed in wetland and WC5 throughflow through wetland habitat. Along the shores of Mud Lake	Overwintering, Rearing, Feeding, Refuge and Passage.	Open Water, Direct connectivity to downstream fish resource
20	Throughflow	WC 3	Open water observed in wetland with intermittent surface water connections to downstream resources	Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource
29	Headwater - outflow (northern extent) Throughflow (southeastern extent)	WC 10 and WC 11	Open water observed in wetland with confirmed surface water connections to downstream resources	Overwintering, Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource
33	Throughflow	WC 11	Fish habitat only within watercourse except in extreme flood events	Overwintering, Feeding, Refuge, and Passage (within wc only)	Open Water, Direct connectivity to downstream fish resource
44	Throughflow	WC 5	Open water observed in wetland with confirmed surface water connections to downstream resources. Currently beaver dam	Overwintering, Rearing, Feeding, Refuge and Passage.	Open Water, Direct connectivity to downstream fish resource

Table 6.6-4 Fish Habitat Present within Each Wetland and Associated Watercourse

WL ID	Hydrological Regime	Associated Watercourse	Potential Fish habitat	Qualitative Description	Habitat Potential
			at outlet causing extensive flooding within the wetland		
46	Throughflow	WC 5	Fish habitat only within watercourse except in extreme flood events	Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource
48	Throughflow	WC 4	Fish habitat only within watercourse except in extreme flood events	Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource
52	Throughflow	WC 5	Fish habitat only within intermittent watercourse except during high water level events	Passage	Open Water, Direct connectivity to downstream fish resource
53	Headwater - outflow	WC 5	Fish habitat only within watercourse except in extreme flood events	Passage	Open Water, Direct connectivity to downstream fish resource
56	Throughflow	WC 12	Fish habitat present where standing water is present – drain system present	Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource
57	Headwater - outflow	WC 14	Fish habitat only within watercourse (northern extent of wetland) except in extreme flood events	Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource
59	Throughflow	WC 12 and WC 14	Open water observed in wetland with confirmed surface water connections to downstream resources	Overwintering, Rearing, Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource
61	Throughflow/bi-directional non-tidal	WC 13 and Cameron Flowage	Open water observed in wetland with confirmed surface water connection to downstream resources	Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource

Table 6.6-4 Fish Habitat Present within Each Wetland and Associated Watercourse

WL ID	Hydrological Regime	Associated Watercourse	Potential Fish habitat	Qualitative Description	Habitat Potential
62	Bi-directional non-tidal	Cameron Flowage	Open water observed along lake edge	Overwintering, Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource
Beaver Dam Haul Road					
64	Throughflow	A	Open water observed in wetland with confirmed surface water connections to downstream resources	Overwintering, Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource
66	Throughflow	B	Fish habitat within open water sections of the wetland.	Rearing, Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource
67	Throughflow	C	Fish habitat only within watercourse except in extreme flood events	Rearing, Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource
68	Throughflow	B and C	Fish habitat within watercourses and shallow open water sections within wetland habitat	Rearing, Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource
69	Lentic/Throughflow	D	Fish habitat present in connected open water – riparian wetland	Overwintering, Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource
73	Throughflow	E	Fish habitat only within intermittent watercourse through the wetland except in extreme flood events	Spawning, Rearing, Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource

Table 6.6-4 Fish Habitat Present within Each Wetland and Associated Watercourse

WL ID	Hydrological Regime	Associated Watercourse	Potential Fish habitat	Qualitative Description	Habitat Potential
74	Throughflow	F	Fish Habitat potential in open water marsh habitat and watercourse	Overwintering, Rearing, Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource
76	Throughflow	G	Open water observed in wetland with presumed surface water connections to downstream resources	Overwintering, Rearing, Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource
79	Throughflow	J, I, and H	Fish habitat only within watercourse except in extreme flood events	Rearing, Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource
94	Throughflow	M	Fish habitat only within intermittent watercourse except in extreme flood events	Rearing, Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource
111	Throughflow	O	Fish habitat only within watercourse except in extreme flood events	Feeding, Refuge, and Passage	Open water, Watercourse intermittent, Connectivity downstream undetermined
112	Headwater - outflow	O	Fish habitat only within watercourse except in extreme flood events	Feeding, Refuge, and Passage	Open water, Watercourse intermittent, Connectivity downstream undetermined

Table 6.6-4 Fish Habitat Present within Each Wetland and Associated Watercourse

WL ID	Hydrological Regime	Associated Watercourse	Potential Fish habitat	Qualitative Description	Habitat Potential
135	Throughflow	Q	Fish habitat only within watercourse except in extreme flood events	Feeding, Refuge, and Passage	Open water, Watercourse intermittent, no surface water connection to downstream resource (subterranean)
137	Throughflow	R	Fish habitat only within watercourse except in extreme flood events	Feeding, Refuge, and Passage	Open water, Watercourse intermittent, no surface water connection to downstream resource (subterranean)
142	Throughflow	W	Fish habitat only within watercourse except in extreme flood events	Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource
143	Throughflow	X	Fish habitat only within watercourse except in extreme flood events	Rearing, Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource
144	Throughflow	Y	Fish habitat only within watercourse except in extreme flood events	Rearing, Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource
146	Headwater - outflow	Z	Open water behind blocked culvert within wetland habitat	Overwintering, Rearing, Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource

Table 6.6-4 Fish Habitat Present within Each Wetland and Associated Watercourse

WL ID	Hydrological Regime	Associated Watercourse	Potential Fish habitat	Qualitative Description	Habitat Potential
154	Headwater - outflow	n/a	Fish habitat within watercourse outlet draining outside of PA and standing water within the wetland	Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource
159	Throughflow	AA	Inundation caused by beaver activity has extended potential fish habitat throughout wetland.	Overwintering, Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource
160	Throughflow	AA	Open water observed in wetland with confirmed surface water connections to downstream resources	Overwintering, Rearing, Feeding, Refuge and Passage.	Open Water, Direct connectivity to downstream fish resource
165	Throughflow	AC	Fish habitat only within watercourse except in extreme flood events. Inlet from ditching, outlet natural channel	Rearing, Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource
171	Throughflow	AD and AE	Fish habitat only within watercourse except in extreme flood events	Spawning, Overwintering, Rearing, Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource
173	Throughflow	AF	Fish habitat only within watercourse except in extreme flood events	Rearing, Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource
174	Headwater - outflow	AG	Fish Habitat only within watercourse.	Feeding, Refuge, and Passage	Open Water, Direct connectivity to downstream fish resource

Twelve wetlands and associated watercourses have been evaluated to provide potential fish habitat based on the NL Guide for the salmonid family within the mine footprint PA. These wetlands are associated with the following surface water systems:

- Crusher Lake: WL8 and WL10
- Mud Lake: WL17
- Cameron Flowage: WL61, WL62
- Watercourse 5 (and smaller tributaries): WL8, WL14, WL17, WL44, WL46, WL52 and WL53
- Watercourse 3: WL4, WL20
- Watercourse 4: WL8, WL13, WL14, WL48
- Watercourse 11: WL29, WL33
- Watercourse 12: WL56, WL59

Most of these wetlands provide habitat that supports feeding, refuge and passage within and through the mine footprint PA surface water systems. Wetlands that provide potential overwintering and rearing habitat are associated with waterbodies and open water features on site. These wetlands include WL8 and 10 (Crusher Lake), WL17 (Mud Lake), WL29 open water section just south of the PA, WL44 (beaver impoundment), WL59 (previous dug waterbody for historical mining activities), and WL62 (Cameron Flowage).

Within the haul road PA, twenty five wetlands have been determined to support potential fish habitat. The haul road PA is linear by nature, so limited evaluation of each watercourse and associated wetland was completed. As a result, fish habitat conclusions especially within this area of the PA should be considered preliminary, as downstream connectivity was not confirmed. Open deep-water marsh habitat providing potential overwintering habitat for salmonids was documented in WL64, WL74, WL76, WL146 (blocked culvert backing water up), WL159 (beaver impoundment), and WL160. The only potential spawning habitat documented associated with wetland habitat within the haul road PA was limited to the watercourse habitat present within/draining through wetland habitat. The majority of wetland habitat identified as potentially supporting fish offers refuge, feeding and passage, with some rearing habitat for fish species.

A desktop evaluation for priority fish species revealed that no priority species were documented within 5km of the Project Area by the Atlantic Canada Conservation Data Centre (ACCDC) reports provided for the mine footprint and for the haul road. No location sensitive species of fish have been identified within 5km of either the mine footprint of the haul road PA. Priority fish species identified as having an elevated potential to be located within the Project Area, based on habitat preferences, and broad geographic range, include *Anguilla rostrata* (American eel), *Salmo salari* (Atlantic salmon), *Culaea inconstans* (Brook Stickleback), *Osmerus mordax* (Landlocked Rainbow smelt), and *Rhinichthys atratulus* (Blacknose dace).

As described, habitat descriptions for all identified watercourses, waterbodies and wetlands that could support fish are based on requirements for the salmonid family (salmon as the indicator species). Atlantic salmon (southern uplands population) (COSEWIC E) were not observed within the PA, but are expected to potentially utilize areas within the PA, as described in this section.

These habitat descriptions are also relevant for Brook trout, which was observed in the PA. Further details relating to Atlantic salmon habitat can be found in Section X (Species at Risk).

American eel (COSEWIC T) was observed within the PA. Suitable habitat for the eel is varied.

As a catadromous species, eels spend the majority of their lives in freshwater, moving to the Sargasso Sea to spawn. Their distribution includes marine waters of the western Atlantic Ocean, and some freshwater systems connected to the Atlantic Ocean in South America, North America and Greenland. Within the freshwater environment, mature American Eels are habitat generalists, frequently found in natural watercourses that offer structural complexity and shade in the form of coarse woody debris, varied substrate, in-stream vegetation and an available food source of forage fish, invertebrates, molluscs and vegetation.

Fish habitat was assessed for various lifecycles of the American Eel. Migration habitat was determined based on a contiguous fresh water system connecting two separate waterbodies. Juvenile habitat requires various benthic substrates, woody debris and or vegetation for protection and cover. Overwintering habitat required mud/silt sections of stream beds with depths of a minimum 30 cm to ensure the watercourse does not freeze to death during winter months.

Potential American Eel habitat was found to be within 30 tributary watercourses to the three confirmed Eel bearing watercourses. Tributary systems were inferred using both field data and NS topographical watercourse mapping. A review of literature documents that American Eels are not restricted to contiguous watercourses and possess the ability to traverse over land in wet, low lying grass habitats (MacGregor et al. 2011). As such all remaining watercourses within the Beaver Dam Mine Project are believed to be potentially accessible to the American Eel, even if habitat provision in those watercourses is low. Detailed assessment of specific American Eel habitat within the PA is provided in Section X (Species at Risk). Details relating to habitat requirements of other species of conservation interest identified within the PA are also found in Section 6.10.

6.6.3.2 Electrofishing

Mine Footprint PA

Within the eight electrofishing locations in the mine footprint, a total of 44 individual fish were captured at five watercourse locations including: Watercourse 4 south of Crusher Lake; Watercourse 5 north of Crusher Lake; Watercourse 12 located between WL 56 and WL 59; Wetland 56 (WL 56); and Watercourse 13 located between WL 59 and Cameron Flowage. No fish were observed in the upper reaches of Watercourse 5 located south of Crusher Lake, or within the two locations fished along Watercourse 3 which drains north through the central portion of the mine footprint PA.

Table 6.6-5 outlines a summary of fish species captured within the mine footprint.

Table 6.6-5 Fish Species Captured within Mine Footprint PA Linear Watercourses

Species	Total Number Captured	Relative Abundance (%)	Species of Commercial, Aboriginal or Recreational (CAR) Interest	Species Ranking (ACCDC)	Average Length per species within Mine Footprint
Brook Trout (*Salvelinus fontinalis*)	10	22.7	Yes	S4	8..6
Ninespine Stickleback (*Pungitius pungitius*)	11	25	No	S5	3.1
Northern Redbelly Dace (*Chrosomus eos*)	9	20.5	No	S5	5.9
Banded Killifish (*Fundulus diaphanous*)	10	22.7	No	S5	6.2
Smallmouth Bass (*Micropterus dolomieui*)	1	2.3	Yes	SNA (exotic)	9
Lake Chub (*Couesius plumbeus*)	1	2.3	No	S5	4.5
Brown Bullhead (*Ictalurus nebulosus*)	1	2.3	No	S5	6.0

Table 6.6-6 presents the results of the individual fish data for fish collected in each watercourse within the mine footprint PA.

Table 6.6-6 Individual Fish Details: Beaver Dam Mine Site

Sampling site	Common name	Scientific name	Fork length (cm)	Total length (cm)	Age[i]
WC4	Ninespine Stickleback	*Pungitius pungitius*		4.0	Mature
	Ninespine Stickleback	*Pungitius pungitius*		5.0	Mature
	Ninespine Stickleback	*Pungitius*		3.0	Immature
	Ninespine Stickleback	*Pungitius*		3.0	Immature
	Ninespine Stickleback	*Pungitius*		3.0	Immature
	Ninespine Stickleback	*Pungitius*		3.0	Immature
	Ninespine Stickleback	*Pungitius pungitius*		3.0	Immature
	Ninespine Stickleback	*Pungitius pungitius*		2.5	Immature
	Ninespine Stickleback	*Pungitius pungitius*		2.5	Immature
	Ninespine Stickleback	*Pungitius pungitius*		2.5	Immature
	Ninespine Stickleback	*Pungitius pungitius*		2.5	Immature
	Slimy Sculpin	*Cottus cognatus*		3.3	Immature
WC5 (top-near WL2)		---No Fish---			

Table 6.6-6 Individual Fish Details: Beaver Dam Mine Site

Sampling site	Common name	Scientific name	Fork length (cm)	Total length (cm)	Age[i]
WC5 (lower- near WL14)	Brook Trout	*Salvelinus fontinalis*	13.0	15.0	Immature
	Northern Redbelly Dace	*Chrosomus eos*	6.0	8.0	Mature
	Northern Redbelly Dace	*Chrosomus eos*	6.0	8.0	Mature
	Northern Redbelly Dace	*Chrosomus eos*	4.8	6.0	Mature
WC3 (top- near WL2)		---No Fish---			
WC3 (lower- near WL20)		---No Fish---			
WC12	Brook Trout	*Salvelinus fontinalis*	6.0	7.0	Immature
	Brook Trout	*Salvelinus fontinalis*	6.0	7.0	Immature
	Brook Trout	*Salvelinus fontinalis*	4.8	6.0	Immature
WL56	Banded Killifish	*Fundulus diaphanus*	3.0	4.0	
	Northern Redbelly Dace	*Chrosomus eos*	3.0	4.0	Immature
WC13	Brook Trout	*Salvelinus fontinalis*	14.0	17.0	Immature
	Brook Trout	*Salvelinus fontinalis*	10.0	12.0	Immature
	Brook Trout	*Salvelinus fontinalis*	4.0	5.0	Immature
	Northern Redbelly Dace	*Chrosomus eos*	5.0	6.0	Mature
	Banded Killifish	*Fundulus diaphanus*	6.5	7.5	
	Northern Redbelly Dace	*Chrosomus eos*	5.0	6.0	
	Brook Trout	*Salvelinus fontinalis*	5.0	6.0	
	Banded Killifish	*Fundulus diaphanus*	5.0	6.0	
	Smallmouth Bass	*Micropterus dolomieui*	8.0	9.0	
	Brook Trout	*Salvelinus fontinalis*	4.2	5.0	
	Banded Killifish	*Fundulus diaphanus*	6.0	7.0	
	Banded Killifish	*Fundulus diaphanus*	6.0	7.0	
	Banded Killifish	*Fundulus diaphanus*	5.0	6.0	
	Lake Chub	*Couesius plumbeus*	4.0	4.5	
	Banded Killifish	*Fundulus diaphanus*	6.0	7.0	
	Banded Killifish	*Fundulus diaphanus*	6.0	7.0	
	Banded Killifish	*Fundulus diaphanus*	5.2	6.0	
	Brook Trout	*Salvelinus fontinalis*	5.0	6.0	

Table 6.6-6 Individual Fish Details: Beaver Dam Mine Site

Sampling site	Common name	Scientific name	Fork length (cm)	Total length (cm)	Age[i]
	Brown Bullhead	*Ictalurus nebulosus*	5.0	6.0	
	Northern Redbelly Dace	*Chrosomus eos*	4.0	5.0	
	Northern Redbelly Dace	*Chrosomus eos*	4.0	5.0	
	Northern Redbelly Dace	*Chrosomus eos*	4.5	5.5	
	Banded Killifish	*Fundulus diaphanus*	3.5	4.0	
WL59	Fish Observed in open water sections, but depth prevented safe sampling.				

Within the mine footprint PA, two species of commercial, aboriginal, or recreational (CAR) interest were confirmed, the Brook Trout and the Smallmouth Bass.

Brook Trout was confirmed within Watercourse 5 north of Crusher Lake (between Crusher Lake and Mud Lake) (one individual fish), Watercourse 12 (three individual fish) (between WL56 and WL59), and within Watercourse 13, the short tributary leading from Cameron Flowage west into Wetland 59 (6 individual fish). Based on the observed Brook Trout in WC5, it is expected that this species would be present and utilizing wetland habitat in WL8 and WL44 on the south side of Crusher Lake, and WL17 adjacent to Mud Lake. Brook Trout was confirmed in WC12, WL56, and WC13 demonstrating that this species is also present in WL56 (where open water is present) and throughout WL59, which is classified as an open water marsh.

Mature Brook Trout, in the fall of the year, migrate to spawn in lakes or streams. Trout mature in about two to four years within fresh water. If the river habitat is suitable for Brook Trout and they do not experience any stressors throughout the year, they tend not to travel large distances. Most of the populations existing in larger rivers act this way. They do not move until the fall at the onset of spawning. Even then, if the river has adequate habitat diversity, they tend not to travel large distances. Other populations have adapted to various river conditions. They travel very large distances (>120 km) in search of thermal refuge and/or spawning habitat. Some spawn in the main stem of rivers, while others utilize tributaries (NS Department of Agriculture and Fisheries, 2005). No maps exist within Nova Scotia to specifically highlight confirmed or potential spawning habitat or migratory routes for Brook Trout. Habitat assessments in Section 6.6.3.1 describe potential habitat within the PA for spawning, nursery, feeding, overwintering for trout. Bathymetry for each watercourse and wetland identified to support fish habitat is provided in Section 6.3 and Section 6.5.

The Smallmouth Bass was confirmed only at Watercourse 13, the tributary adjacent to Cameron Flowage with one individual fish caught. Smallmouth Bass migrate seasonally and some populations are non-migratory. Lake populations of Smallmouth Bass have short spawning migrations. Most adult Smallmouth Bass migrate downriver in late June and July and repeatedly migrate back to the same nesting site each year (Brown, Runciman, Pollard, Grant, & Bradford, 2009). Smallmouth Bass are considered an exotic species in Nova Scotia and care should be taken when considering project design to avoid continued spreading of this fish species throughout surface water systems. Consultation with DFO will be completed with respect to this species at the permitting stage. No maps exist within Nova Scotia with confirmed or potential spawning habitat and/or migratory routes for Smallmouth Bass

No fish species at risk (SAR) or species of conservation interest (SOCI) were captured within the mine footprint PA during electrofishing surveys.

Haul Road PA

Within the seven electrofishing locations in the haul road PA, a total of 53 individual fish were captured at four watercourse locations including: Watercourse N (West River Sheet Harbour), Watercourse V (tributary draining into Lake Alma), Watercourse AA (tributary between Mink and Brady Lake), and Watercourse AH (tributary draining to the Morgan River). No fish were captured in Watercourse B or Watercourse H. Both are located at the top of the Tent Lake and Brandon Lake tertiary watersheds respectively. As well, no fish were captured within Watercourse O, a tributary located within the upper reaches of the Lake Alma tertiary watershed.

Table 6.6-7 outlines a summary of fish species captured within the haul road PA.

Table 6.6-7 Fish Species Captured within the Haul Road PA Linear Watercourses

Species	Total Number Captured	Relative Abundance %	Species of Commercial, Aboriginal or Recreational (CAR) Interest	Species Ranking	Average Length per species within Haul Road Footprint
American Eel (*Anguilla rostrata*)	36	60	Yes	COSEWIC T/S5	24.0
Banded Killifish (*Fundulus diaphanous*)	6	10	No	S5	7.5
Blacknose Dace (*Rhinichthys atratulus*)	1	1.7	No	S3	9
Brook Trout (*Salvelinus fontinalis*)	7	11.67	Yes	S4	11.54
Golden Shiner (*Notemigonus crysoleucas*)	2	3.3	No	S5	8.75
Lake Chub (*Couesius plumbeus*)	2	3.3	No	S5	8.5
White Sucker (*Catostomus commersoni*)	5	8.3	Yes	S5	16.3
Yellow Perch (*Perca flavescens*)	1	1.7	Yes	S5	8.5

Table 6.6-8 presents the results of the individual fish data for fish collected in each watercourse within the haul road PA.

Table 6.6-8 Individual fish Details: Beaver Dam Haul Road

Watercourse	Common name	Scientific Name	Fork Length (cm)	Total Length (cm)
B	---No Fish---			
H	---No Fish---			
N	Yellow Perch	*Perca flavescens*	8	8.5
	White Sucker	*Catostomus commersoni*	16	18
	Banded Killifish	*Fundulus diaphanus*	7.25	7.5
	Blacknose Dace	*Rhinichthys atratulus*	8.5	9
	American Eel	*Anguilla rostrata*	-	21
	American Eel	*Anguilla rostrata*	-	18
	American Eel	*Anguilla rostrata*	-	12
	American Eel	*Anguilla rostrata*	-	29
	American Eel	*Anguilla rostrata*	-	15
	American Eel	*Anguilla rostrata*	-	31
	American Eel	*Anguilla rostrata*	-	27
	American Eel	*Anguilla rostrata*	-	30
	American Eel	*Anguilla rostrata*	-	25
	American Eel	*Anguilla rostrata*	-	20
	American Eel	*Anguilla rostrata*	-	10
	American Eel	*Anguilla rostrata*	-	11
	American Eel	*Anguilla rostrata*	-	15
	American Eel	*Anguilla rostrata*	-	19
	American Eel	*Anguilla rostrata*	-	35
	White Sucker	*Catostomus commersoni*	24	25
	Banded Killifish	*Fundulus diaphanus*	7	7.5
	White Sucker	*Catostomus commersoni*	17	18
	Brook Trout	*Salvelinus fontinalis*	6.5	7
	American Eel	*Anguilla rostrata*	-	45
	Lake Chub	*Couesius plumbeus*	7.5	8
	American Eel	*Anguilla rostrata*	-	30
	American Eel	*Anguilla rostrata*	-	27

Table 6.6-8 Individual fish Details: Beaver Dam Haul Road

Watercourse	Common name	Scientific Name	Fork Length (cm)	Total Length (cm)
	American Eel	*Anguilla rostrata*	-	45
	American Eel	*Anguilla rostrata*	-	20
	American Eel	*Anguilla rostrata*	-	19
O	---No Fish---			
V	American Eel	*Anguilla rostrata*		20
	Brook Trout	*Salvelinus fontinalis*	10	10.5
	Brook Trout	*Salvelinus fontinalis*	6	6.25
	Brook Trout	*Salvelinus fontinalis*	14.5	15
	Brook Trout	*Salvelinus fontinalis*	19.5	20
	Brook Trout	*Salvelinus fontinalis*	5.25	5.5
	American Eel	*Anguilla rostrata*	-	31
AA	Banded Killifish	*Fundulus diaphanous*	-	8
	Golden Shiner	*Notemigonus crysoleucas*	7	8
	Lake Chub	*Couesius plumbeus*	8.5	9
	White Sucker	*Catostomus commersoni*	9.5	10
	White Sucker	*Catostomus commersoni*	9.5	10.5
	Banded Killifish	*Fundulus diaphanous*	-	7.25
	Banded Killifish	*Fundulus diaphanous*	-	7
	Banded Killifish	*Fundulus diaphanous*	-	8
	Golden Shiner	*Notemigonus crysoleucas*	9.5	9.5
AH	Brook Trout	*Salvelinus fontinalis*	19	20
	American Eel	*Anguilla rostrata*	-	23
	American Eel	*Anguilla rostrata*	-	35
	American Eel	*Anguilla rostrata*	-	29
	American Eel	*Anguilla rostrata*	-	14
	American Eel	*Anguilla rostrata*	-	31
	American Eel	*Anguilla rostrata*	-	17

Table 6.6-8 Individual fish Details: Beaver Dam Haul Road

Watercourse	Common name	Scientific Name	Fork Length (cm)	Total Length (cm)
	American Eel	*Anguilla rostrata*	-	22
	American Eel	*Anguilla rostrata*	-	10
	American Eel	*Anguilla rostrata*	-	17
	American Eel	*Anguilla rostrata*	-	24
	American Eel	*Anguilla rostrata*	-	32
	American Eel	*Anguilla rostrata*	-	36
	American Eel	*Anguilla rostrata*	-	20

Within the haul road PA, four species of commercial, aboriginal, or recreational (CAR) interest were confirmed, the Brook Trout, American Eel, White Sucker and Yellow Perch. Brook Trout (7) and American Eel (36) were confirmed at Watercourse N (West River Sheet Harbour), Watercourse V (Tributary to Lake Alma), and Watercourse AH (Tributary to the Morgan River). White Sucker (5) were confirmed at Watercourse N (West River Sheet Harbour) and Watercourse AA (tributary to Lake Alma). Based on the presence of the White Sucker at Watercourse AA, this species is also expected to be present in WL159 and WL160. The Yellow Perch was confirmed at Watercourse N (West River Sheet Harbour). Brook Trout and American Eel were confirmed at Watercourse AH, indicating these species will also be utilizing any associated available wetland habitat in WL171, WL173 and WL174 within the haul road PA.

American eel habitat and Brook trout habitat have been described in previous sections.

Most Yellow Perch do not appear to migrate, but some do choose to migrate, in patterns, which tend to be short and local (Brown, Runciman, Bradford, & Pollard, 2009). The yellow perch is a schooling, shallow water fish that can adapt to a wide variety of warm or cool habitats. They are found in large lakes, small ponds, or gentle rivers but are most abundant in clear, weedy lakes that have muck, sand, or gravel bottoms. They prefer summer temperatures of 21-24 C. Yellow perch feed on aquatic insects, crustaceans, and a variety of fishes and their eggs (Adopt a Stream)

Spawning occurs from April through July, but usually during May in Nova Scotia, at water temperatures of 9-12 C. The adults move into shallow areas of lakes or up into tributary streams. Males are first to arrive and the last to leave. Yellow perch spawn at night or in early morning, most often in areas where there is debris or vegetation on the bottom. (Adopt a Stream).

In spring (May and June), White Suckers migrate into spawning streams, based on temperature of the streams, approximately 10 - 18^{o}C, to spawn. The adults leave the spawning ground after a week or two and return to the river or lake they originated from (NL Department of Environment and Climate Change, n.d.) and Adopt a Stream.

No maps exist within Nova Scotia with confirmed or potential spawning habitat and/or migratory routes for Yellow Sucker and White Perch.

Two fish species at risk (SAR) or species of conservation interest (SOCI) were captured within the haul road PA during electrofishing surveys: the American eel (COSEWIC T) and the Blacknose dace (S3). Details relating to these species are provided in Section 6.10.3.1.

6.6.3.3 Fish Collection

Fish collection was completed to support electrofishing and fish habitat surveys across the mine footprint and the haul road PA. The focus of fish collection efforts was within two waterbodies within the mine footprint (Crusher Lake and Cameron Flowage) where fyke nets, minnow traps and eel pots were deployed at two locations within each waterbody to collect additional information about fish species and abundance within the PA. Minnow traps were also deployed within linear watercourses within the haul road PA during electrofishing, but as no lakes or other larger waterbodies are present within the haul road footprint, no significant fish collection effort was completed within this portion of the PA.

Mine Footprint PA

<u>Crusher Lake Fish Collection:</u> A total of eight individual fish of two species were captured during netting at Crusher Lake Site A: Banded Killifish (*Fundulus diaphanus*; n=6) and Golden Shiner (*Notemigonus crysoleucas*; n=2). A total of six individual fish of two species were captured during netting at Crusher Lake Site B: Brown Bullhead (*Ictalurus nebulosus*; n=3) and Golden Shiner (*Notemigonus crysoleucas*; n=3).

Within Crusher Lake (both sampling locations) the relative abundance for the Banded Killifish is 42.9%, the Golden Shiner is 35.7% and the Brown Bullhead is 21.4%.

Table 6.6-9 Fish Species Captured within Crusher Lake Sites A and B

Species	Total Number Captured	Relative Abundance (%)	Species of Commercial, Aboriginal or Recreational (CAR) Interest	Species Ranking (ACCDC)	Average Length per species within Crusher Lake
Banded Killifish (*Fundulus diaphanous*)	6	42.9	No	S5	8.45
Brown Bullhead (Ictalurus nebulosus)	3	21.4	No	S5	13.33
Golden Shiner (*Notemigonus crysoleucas*)	5	35.7	No	S5	8.63

Table 6.6-10 presents the results of the individual fish data collected at Site A and B within Crusher Lake.

Table 6.6-10 Individual Fish Data: Crusher Lake

Site	Equipment	Species	Scientific Name	Fork Length (cm)	Total Length (cm)
A	Eel Pot	Banded Killifish	*Fundulus diaphanous*		8.9
A		Banded Killifish	Fundulus diaphanous		8.5
A		Banded Killifish	Fundulus diaphanous		7.4
A		Banded Killifish	Fundulus diaphanous		8.8
A		Banded Killifish	Fundulus diaphanous		8.4
A		Banded Killifish	Fundulus diaphanous		8.7
A		Golden Shiner	*Notemigonus crysoleucas*	7.9	8.5
A		Golden Shiner	*Notemigonus crysoleucas*	8.0	8.4
A	Fyke Net	-No Fish-			
A	Minnow Trap 1	-No Fish-			
A	Minnow Trap 2	-No Fish-			
B	Eel Pot	Golden Shiner	*Notemigonus crysoleucas*	8.5	9.0
B		Brown Bullhead	Ictalurus nebulosus		12.5
B	Fyke Net	Brown Bullhead	Ictalurus nebulosus		11.5
B		Brown Bullhead	Ictalurus nebulosus		16.0
B		Golden Shiner*	*Notemigonus crysoleucas*		
B	Minnow Trap 1	-No Fish-			
B	Minnow Trap 2	Golden Shiner	*Notemigonus crysoleucas*	7.3	8.0

*Note: Predation occurred on Golden Shiner in fyke net.

No CAR species or SAR/SOCI species were captured during fish collection efforts in Crusher Lake. Brook Trout were identified just north of Crusher Lake in WC5, and are expected to be present in Crusher Lake, based on direct connectivity of WC5 to Crusher Lake.

Cameron Flowage Fish Collection: A total of 15 individual fish of four species were captured during the surveys within Cameron Flowage Site A: Brown Bullhead (*Ictalurus nebulosus*; n=2), Golden Shiner (*Notemigonus crysoleucas*; n=5), White Sucker (*Catostomus commersoni*; n=1) and Yellow Perch (*Perca flavescens*; n=7). A total of 12 individual fish of two species were captured during the surveys within Cameron Flowage Site B: White Sucker (*Catostomus commersoni*; n=1) and Yellow Perch (*Perca flavescens*; n=11).

Within Cameron Flowage (both sampling locations) the relative abundance of the Yellow Perch is 66.7%, Golden Shiner is 18.5% and the White Sucker and Brown Bullhead are both at 7.4%.

Table 6.6-11 Fish Species Captured within Cameron Flowage Sites A and B

Species	Total Number Captured	Relative Abundance (%)	Species of Commercial, Aboriginal or Recreational (CAR) Interest	Species Ranking (ACCDC)	Average Length per species within Cameron Flowage
Brown Bullhead (Ictalurus nebulosus)	2	7.4	No	S5	9.80
Golden Shiner (*Notemigonus crysoleucas*)	5	18.5	No	S5	9.72
White Sucker (*Catostomus commersoni*)	2	7.4	Yes	S5	14.55
Yellow Perch (*Perca flavescens*)	18	66.7	Yes	S5	10.62

Table 6.6-12 presents the results of the individual fish data collected at Site A and B within Cameron Flowage.

Table6.6-12 Individual Fish Data: Cameron Flowage

Site	Equipment	Species	Scientific Name	Fork Length (cm)	Total Length (cm)
A	Eel Pot	Yellow Perch	*Perca flavescens*	12.3	13.5
A		Yellow Perch	*Perca flavescens*	10.2	12.0
A		Yellow Perch	*Perca flavescens*	7.3	8.9
A		Yellow Perch	*Perca flavescens*	8.7	10.2
A		Golden Shiner	*Notemigonus crysoleucas*	8.4	9.5
A		Yellow Perch	*Perca flavescens*	10.2	11.9
A	Fyke Net	Yellow Perch	*Perca flavescens*	11.1	11.9
A		Yellow Perch	*Perca flavescens*	12.1	12.9
A		White Sucker	*Catostomus commersoni*	13.9	15.7
A	Minnow Trap 1	Golden Shiner	*Notemigonus crysoleucas*	9.2	10.1
A		Golden Shiner	*Notemigonus crysoleucas*	9.4	10.1
A		Golden Shiner	*Notemigonus crysoleucas*	9.4	10.1
A	Minnow Trap 2	Golden Shiner	*Notemigonus crysoleucas*	7.9	8.8
A		Brown Bullhead	*Ictalurus nebulosus*	-	10.0
A		Brown Bullhead	*Ictalurus nebulosus*	-	9.6

Table6.6-12 Individual Fish Data: Cameron Flowage

Site	Equipment	Species	Scientific Name	Fork Length (cm)	Total Length (cm)
B	Eel Pot	Yellow Perch	*Perca flavescens*	11.2	11.7
B		Yellow Perch	*Perca flavescens*	9.5	10.1
B		Yellow Perch	*Perca flavescens*	7.8	9.1
B	Fyke Net	Yellow Perch	*Perca flavescens*	11.4	12.0
B	Minnow Trap 1	Yellow Perch	*Perca flavescens*	8.7	9.1
B		Yellow Perch	*Perca flavescens*	9.6	9.9
B		Yellow Perch	*Perca flavescens*	8.5	9.0
B		Yellow Perch	*Perca flavescens*	8.9	9.3
B		Yellow Perch	*Perca flavescens*	12.5	12.9
B		Yellow Perch	*Perca flavescens*	8.4	9.1
B		Yellow Perch	*Perca flavescens*	7.2	7.6
B		White Sucker	*Catostomus commersoni*	13.0	13.4
B	Minnow Trap 2	No Fish			

Two CAR species were captured in Cameron Flowage: Yellow Perch and White Sucker. Neither of these species was identified during electrofishing surveys within the mine footprint PA. Presence of Yellow Perch and White Sucker within Cameron Flowage indicates that these species may also be present within WL59 (no fishing efforts were completed within this open water marsh), WC12 and WL56 (where open water is present). Fish collection was not completed in Mud Lake during the fish surveys in 2016. Mud Lake is present approximately 2 km upstream of Cameron Flowage (in a circular fashion), and it is reasonable to assume that species present in Cameron Flowage would also likely be present within Mud Lake and its associated wetland habitat (WL17).

No SAR/SOCI species were identified during fish collection in Cameron Flowage.

Haul Road PA

Minnow traps were deployed where possible during electrofishing surveys within the haul road PA watercourses to supplement fish habitat and electrofishing surveys. Limited water depth and lack of deeper pools in watercourses within the haul road PA resulted in limited fish collection opportunities. Where minnow traps were deployed, only one Brook Trout was captured in Watercourse V (tributary to Lake Alma). Brook Trout was also captured during electrofishing surveys in this same watercourse, along with the American Eel.

Table 6.6-13 Fish Species Captured along the Haul Road Watercourses

Watercourse	TEXT HERE	Species	Scientific Name	Fork Length (cm)	Total Length (cm)
B	Minnow Trap 1	---No Fish---			
B	Minnow Trap 2	---No Fish---			
B	Minnow Trap 3	---No Fish---			
N	Minnow Trap 1	---No Fish---			
N	Minnow Trap 2	---No Fish---			
N	Minnow Trap 3	---No Fish---			
V	Minnow Trap 1	Brook trout	*Salvelinus fontinalis*	6.75	7.0
V	Minnow Trap 2	---No Fish---			

*Watercourses H, O, AA, and AH did not have enough depth in pooling water to allow for deployment of minnow traps.

6.6.3.4 Characterization of Fish Populations

Table 6.6-14 outlines the results of the two-pass depletion analyses for fish populations for the watercourses within the haul road PA where electro-fishing was completed in 2016. The two-pass method allows for calculation of fish density estimates.

Table 6.6-14 Two-Pass depletion population estimates for fish caught within the Haul Road PA

Species	Watercourse	N	Variance of N	Standard Error of N
American Eel (*Anguilla rostrata*)	N	25	25.926	5.092
	V	NA*	NA*	NA*
	AH	16.2	26.957	5.192
Banded Killifish (*Fundulus diaphanous*)	N	NA*	NA*	NA*
	AA	NA*	NA*	NA*
Blacknose Dace (*Rhinichthys atratulus*)	N	1	0	0
Brook Trout (*Salvelinus fontinalis*)	N	NA*	NA*	NA*
	V	8	24	4.899
	AH	1	0	0
Golden Shiner (*Notemigonus crysoleucas*)	AA	NA*	NA*	NA*

Table 6.6-14 Two-Pass depletion population estimates for fish caught within the Haul Road PA

Species	Watercourse	N	Variance of N	Standard Error of N
Lake Chub (*Couesius plumbeus*)	N	NA*	NA*	NA*
	AA	1	0	0
White Sucker (*Catostomus commersoni*)	N	NA*	NA*	NA*
	AA	1	0	0
Yellow Perch (*Perca flavescens*)	N	1	0	0
Notes: N = population estimate; * Two pass estimates fail if the catch on the second pass equals or exceeds that on the first pass (Heimbuch et al., 1997).				

The total number of fish of each species was used to estimate the fish populations using the Two-Pass depletion method. These numbers form a baseline estimate of population that can be compared between sites and, over time, at each of the watercourses within the haul road PA.

Single-pass surveys provide a representative index of species diversity (Reid et al., 2009). Single-pass electrofishing can be used to detect spatial and temporal trends in abundance and species richness given standardized effort, but may not be representative of absolute population densities (Bertrand et al., 2006). Single pass surveys were completed within watercourses in the mine footprint PA from electrofishing surveys in 2015. This method allows for calculation of catch per unit effort (standardized quantification of species richness and identification of trends). This calculation was also completed for fish collection efforts (netting) within the mine footprint PA completed in 2016.

Table 6.6-15 Catch Per Unit Effort (CPUE) for Linear Watercourses in Mine Footprint PA

Watercourse	CPUE
WC 4	0.858
WC5 (top near WL2	NA
WC5 (lower near WL14)	0.233
WC3 (top near WL2)	NA
WC3 (lower near WL20	NA
WC12	0.923
WL 56	0.531
WC 13	7.005
WL59	NA
Note: NA - No fish were caught.	

Table 6.6-16 Catch Per Unit Effort (CPUE) for Cameron Flowage and Crusher Lake

Site	Equipment	CPUE
Cameron Flowage		
A	Eel	1.401
	Fyke	0.610
	Minnow 1	0.604
	Minnow 2	0.717
B	Eel	0.616
	Fyke	0.195
	Minnow 1	1.574
	Minnow 2	NA
Crusher Lake		
A	Eel	1.690259877
	Fyke	NA
	Minnow 1	NA
	Minnow 2	NA
B	Eel	0.456308465
	Fyke	0.679194023
	Minnow 1	NA
	Minnow 2	0.228154232
	Minnow 1	NA
	Minnow 2	0.228154232
Note: NA - No fish were caught		

The total number of fish of each species was used to calculate Catch per unit effort (CPUE) for each piece of fishing equipment. The numbers form a baseline estimate of catch per unit effort that can be compared between sites and, over time, at each of the watercourses within the mine footprint PA and within Cameron and Crusher Lakes.

6.6.3.5 Water Quality

Water quality results are reported and discussed as it relates to the chemical characteristics required for suitable fish habitat. Where applicable, water quality sampling results are measured against the Canadian Council for Ministers of the Environment (CCME) Guidelines for the Protection of Aquatic Life (FWALs). Summaries of water quality measurements are presented in Table 6.6-17 and 6.6-18 for linear watercourses and Cameron Flowage in the mine footprint and the haul road PA respectively.

Table 6.6-17 Water quality measurements in the mine footprint PA

Watercourse	Sampling Date	Water Temp. (°C)	pH	Dissolved Oxygen (mg/L)	TDS (g/L)
WC3 (top- near WL2)	Sept 18, 2015	16.35	4.66	18.09	0.02
WC3 (lower- near WL20)	Sept 18, 2015	18.71	4.3	18.45	0.02
WC4	Sept 17, 2015	13.50	5.98	14.36	0.05
WC5 (top- near WL2)	Sept 17, 2015	17.87	5.10	19.99	0.05
WC5 (lower- near WL14)	Sept 17, 2015	19.85	4.16	18.13	0.02
WC12	Sept 18, 2015	14.13	5.54	14.11	0.05
WC13	Sept 18, 2015	22.1	5.36	17.34	0.03
WL59	Sept 18, 2015	23.43	6.31	15.85	0.03
WL 56	Sept 18, 2015	16.56	5.40	17.60	0.03
Benthic Sampling Locations (2016)					
WC13	June 24, 2016	21.10	5.37	6.92	0.03
WC4	June 24, 2016	13.8	6.55	9.28	0.02
WC5	June 24, 2016	20.4	6.42	8.15	0.01
Fish Collection Locations (2016)					
Cameron Flowage	June 24, 2016	21.8	6.71	7.42	0.02

Table 6.6-18 Water quality measurements within the haul road PA

Watercourse	Sampling Date	Water Temp. (°C)	pH	Dissolved Oxygen (mg/L)	TDS (g/L)
B	June 22, 2016	22.1	4.61	3.9	0.05
H	June 22, 2016	18.2	6.19	6.3	0.05
N	June 22, 2016	18.9	5.65	8.7	0.02
O	June 23, 2016	14.0	6.04	5.3	-
V	June 23, 2016	15.5	3.43	9.3	0.05
AA	June 23, 2016	20.5	5.39	6.6	-
AH	June 23, 2016	19.5	5.53	7.4	-
Note: TDS was not collected at Watercourse Q, AC and AJ based on available parameters on the field measurement device.					

Fish species of commercial, aboriginal, or recreational interest (CAR species) identified within the PA include Brook Trout, White sucker, Yellow Perch, Smallmouth Bass, and American Eel. SAR/SOCI fish species identified include the American Eel (also a CAR species) and the Blacknose Dace. The Atlantic salmon (southern uplands population) is also potentially present within the PA, and is confirmed to be in surrounding watercourses (Killag River and West River Sheet Harbour). The Atlantic salmon was not observed during electrofishing and fish collection surveys within the PA.

The Nova Scotia Trout Management Plan NS (NSDAF, 2005) identifies three classes of streams based on water quality and pH for trout species (including Brook Trout which is present within the Beaver Dam Mine PA). Class A streams (Cool) require the average summer temperature to be <16.5 degrees Celsius. Class B streams (intermediate) temperature (average summer) ranges from 16-5-19 degrees Celsius. Finally, Class C streams (warm) require temperatures above 19 degrees or pH of <4.7 (NSDAF, 2005). The identification, maintenance, protection, and enhancement of instream habitats of class A and class B waters can benefit the trout fishery. Average summer temperatures were not collected as part of baseline surveys completed within the Beaver Dam Mine PA. However, results shown in Tables 6.6-17 and 18 can provide information relating to the generally quality of the streams present within the PA for trout. Streams with elevated temperatures in June (WC B, AA, AH for example) would likely demonstrate average temperatures above 19 degrees Celsius and be classified as warm streams (lower quality for trout). Watercourse 3 and Watercourse V also have low pH indicating they are Class C (warm) streams. Watercourse 4, Watercourse 12 and Watercourse O indicate potential Class A streams (cool) based on temperature readings available (not confirmed average summer temperatures).

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

Trout and salmon are coldwater fish species, meaning they require cold water to live and reproduce. The optimal temperature range for these species (growth of juvenile) is 10-20^{o}C (The Stream Steward, n.d.) to 16-20^{o}C (Fisheries and Oceans Canada, 2012) (trout and salmon, respectively). Other CAR species observed have higher temperature ranges: Blacknose Dace 19-25^{o}C (Ontario Freshwater Fishes Life History Database, n.d.), Yellow Perch 21-24^{o}C (Brown, Runciman, Bradford, & Pollard, 2009), and White Sucker 19-26^{o}C (Kelly, 2014). American Eels have a broader temperature range and can tolerate temperatures from 4 to 25 ºC ("American Eel Fact Sheet," 2006).

Temperatures recorded in watercourses during electrofishing and fish collection in September 2015 and June 2016 ranged from 13.5^{0}C (WC4 within mine footprint) to 23.43 ^{0}C (WL59 within mine footprint). Generally, the range of temperatures within watercourses is within the required ranges for the species identified during field surveys. The warmer temperatures identified in WC13 and WL59 in the mine footprint PA, and WCB and WCAA within the haul road PA are above the optimal range for salmonids including the Brook Trout and the Atlantic salmon (if present).

The CCME guidelines for the Protection of Aquatic Life establish that a range of pH from 6.5 to 9.0 is suitable within freshwater habitat. All watercourses measured in 2015 within the mine footprint PA had pH levels below the range suitable for fish within freshwater habitat (see Table 6.6-17). In 2016, during a benthic sampling event, the pH in WC4 was recorded slightly higher than in 2015 and just within the lower end of the acceptable CCME range at 6.55. The pH within Cameron Flowage was recorded at 6.71 in 2016. Levels of pH in all watercourses within the haul road PA reported below the range suitable for fish within freshwater habitat (Table 6.6-18).

Levels of pH that were reported below the suitable range indicate the presence of acidification within watercourses across the PA. Kalff (2002) indicates that the loss of fish populations is gradual and depends on fish species, but decline is evident when pH is <6.5. He further states that a 10-20% species loss is apparent when pH<5.5.

The survival of juvenile rearing of Atlantic salmon requires freshwater pH >4.7. The Recovery Potential Assessment for the salmon completed by Fisheries and Oceans Canada indicates that acidification is an extreme threat to the salmon population (Gibson and Bowlby, 2013). Yellow Perch are found in Ontario lakes with a pH range from approximately 3.9 to 9.5. Yellow Perch are relatively tolerant of low pH, but reproductive success is reduced in lakes with pH < 5.5 (Krieger, Terrell, & Nelson, 1983). White Suckers have been collected from areas with a pH as low as 4.3 (Dunson and Martin, 1973, as cited in Twomey, Williamson, & Nelson, 1984), but Beamish (1974) reported sharp declines in White Sucker populations in Canadian lakes when the pH was lowered to 4.5 to 5.0 as a result of acid precipitation. Brook Trout tolerate acidic conditions particularly well, compared with other species. They have been known to survive at pH 3.5, though only in unusual circumstances. Realistically, the lower limits are around pH 4.8 (Soil & Water Conservation Society of Metro Halifax, 2016). American Eels are also more tolerant of low pH than are many other species, although densities and growth rates may be adversely affected by direct mortalities or declining abundance of prey as productivity declines at low pH (Jessop, 1995).

The atmosphere and photosynthesis by aquatic vegetation are the major sources of DO in water (CCME, 1999a). However, the amount of oxygen available for aquatic life (i.e. the concentration of oxygen in water) is affected by several independent variables including water temperature, atmospheric and hydrostatic pressure, microbial respiration, and growth of aquatic vegetation; DO can vary daily and seasonally (CCME, 1999a). The CCME guidelines for the Protection of Aquatic Life establish a minimum recommended concentration of DO of 9.5 mg/L for early life stages of cold water biota and 6.5 mg/L for other life stages (CCME, 1999a). DO levels recorded across the watercourses and waterbodies within the PA were above the recommended concentrations for both life stages of cold water biota.

Total Dissolved Solids (TDS) is a measurement of inorganic salts, organic matter and other dissolved materials in water. TDS causes toxicity through increases in salinity, changes in the ionic composition of the water and toxicity of individual ions. TDS field measurements within PA watercourses range from 0.01 to 0.05 g/L (10-50 mg/L TDS). A recent study by Weber-Scannell & Duffy (2007) reported a variety of studies that evaluated the effect of elevated TDS on freshwater aquatic invertebrates. These studies reported the commencement of effect at 499 mg/L, and most effects aren't observed until >1000 mg/L. With fish, research is limited, but preliminary studies reported in Weber-Scannell and Duffy demonstrated survival rates of salmonid embryos to elevated TDS (38% survival when exposed to 2229 mg/L for Brook trout, and 35% survival when exposed to 1395 mg/L). TDS field measurements within PA watercourses were reported between 10-50 mg/L.

6.6.3.6 Aquatic Ecosystem Condition

The total number of animals of each type (taxonomic group), as well as total abundance, was determined for each sample collected from the watercourses within the Beaver Dam PA. These numbers were used to calculate several indices of baseline benthic community health, which can be compared between sites and, with time, at each site (an index of community health is like a body mass index or an IQ, which gives a single number that can be used to compare individuals or things). Indices calculated are all commonly used in studies of this kind and include: EPT Ratio

(ratio of abundance of mayflies (Ephemeroptera), caddisflies (Trichoptera), and stoneflies (Plecoptera), to total numbers of organisms); Total Abundance (number of animals in the sample and per unit area); and Taxon Richness (number of taxa per sample). Abundance in kicknet samples was expressed on a per sample basis. All organisms present were included in estimates. Sediment descriptions for the ten samples (and associated sub-set samples) are presented in Table 6.6-19. Species identifications, Total Abundance, Taxon Richness and EPT Ratio measures are presented in Table 6.6-20.

Samples were dominated in numbers by Diptera (fly) larvae, principally midges (Chironomidae) at all sites and by juvenile clams (Bivalves), predominantly Sphaeriidae at Watercourse 13. Caddisfly larvae (Trichoptera) occurred frequently at all sites with the exception of one (WC B.b), and may fly larvae (Ephemeroptera) occurred at twelve of the fourteen sites. Aquatic beetle larvae (Coleoptera), dragonfly/damselfly larvae (Odonata), stonefly larvae (Plecoptera) and dobsonfly/fishfly larvae (Megaloptera) occurred frequently at most sites. Aquatic Hemiptera (i.e. Gerridae, Corixidae, etc.) also occurred in many of the sites, as well as crustaceans, including the amphipod Hyalella azteca (found only at Watercourse 13), and copepods & cladocera (found at a total of eight sites).

Table 6.6-19 Sediment Characteristics at each Benthic Sampling Location

Characteristics of Sediments in kicknet samples, Beaver Dam collected June 22-24, 2016.	
Sample	**Sediment Description**
Mine Footprint PA	
Watercourse 4	Abundant fines (mud) with organics (woody, plant and other organic debris) and occasional animal casings.
Watercourse 5	Fines and medium to fine sand with organics (woody, plant and other organic debris) and occasional animal casings.
Watercourse 13	Sand with organics (woody, plant and other organic debris) and occasional mollusk shells and animal casings.
Haul Road PA	
Watercourse B.a	Silt to fine sand with detritus, plant and woody debris and animal casings.
Watercourse B.b	Silt with minor amounts fine to medium sand, as well as, organics (woody, plant and other organic debris) and large amounts of animal casings.
Watercourse B.c	Silt with minor amounts fine sand, as well as, organics (woody, plant and other organic debris) and large amounts of animal casings.
Watercourse B.d	Silt with minor amounts fine to medium sand, as well as organics (woody, plant and other organic debris) and large amounts of animal casings.
Watercourse H	Abundant amounts of organics (plant, woody and other organic debris) with occasional silt and sand, as well as animal casings.

Table 6.6-19 Sediment Characteristics at each Benthic Sampling Location

Characteristics of Sediments in kicknet samples, Beaver Dam collected June 22-24, 2016.	
Watercourse N	Coarse sand to silt with organics (plant, woody and other organic debris).
Watercourse V	Medium to coarse sand with occasional fines and organics (plant, woody and other organic debris), as well as animal casings.
Watercourse AA	Medium to coarse sand and organics (plant, woody and other organic debris), as well as animal casings.
Watercourse AH	Medium to coarse sand and organics (plant, woody and other organic debris), as well as occasional animal casings.
Watercourse O.a	Medium to coarse sand and organics (plant, woody and other organic debris), as well as occasional animal casings. Sample material had a noticeable film coating it, before washing.
Watercourse O.b	Medium to coarse sand and organics (plant, woody and other organic debris). Sample material had a noticeable film coating it, before washing.
Grain size classes: cobble = 6.4 cm and larger; pebble/gravel = 4 mm to 6.4 cm; sand = 0.063 mm to 2 mm; silt = 0.004 mm to 0.063 mm; clay = <0.004 mm.	

Table 6.6-20 Total Abundance, Benthic Sampling Locations

Total Abundance of organisms from samples, Beaver Dam, Nova Scotia, June 22-24, 2016.							
Location	Watercourse NNNNN						
	4	5	13	B.a	B.b	B.c	B.d
Abundance	#	#	#	#	#	#	#
Diptera							
Certapogonidae-*Probezzia/Bezzia* sp	0	0	2	6	10	7	2
Chironomidae larvae	114	809	361	133	165	213	136
Chironomidae pupae	2	13	13	5	7	5	3
Diptera adult	0	1	0	1	0	1	0
Diptera larvae	0	2	0	0	0	0	1
Empididae larvae	0	0	0	0	0	0	0
Simuliidae larvae	1	6	5	1	0	0	0

Table 6.6-20 Total Abundance, Benthic Sampling Locations

Total Abundance of organisms from samples, Beaver Dam, Nova Scotia, June 22-24, 2016.							
Location	Watercourse NNNNN						
	4	5	13	B.a	B.b	B.c	B.d
Abundance	#	#	#	#	#	#	#
Simuliidae pupae	0	3	0	0	1	0	0
Tipulidae larvae	0	0	0	0	1	0	0
Coleoptera							
Dytiscidae adult	2	0	0	0	0	0	0
Dysticidae larvae-*Ilybius*? sp	0	1	0	0	0	0	0
Dytiscidae larvae-*Hydroporus/Hygrotus* sp	1	0	0	0	0	0	0
Elimidae adult	1	0	0	0	0	0	0
Elmidae larvae-*Stenelmis* sp	0	8	9	0	0	0	0
Hydrophilidae adult	0	1	0	0	0	0	0
Ephemeroptera							
Ephemerellidae-*Eurylophella* sp	0	1	0	0	0	0	0
Ephemerellidae	0	0	1	0	0	0	0
Ephemeroptera-sp A	0	0	16	0	0	0	0
Ephemeroptera-sp B	0	0	4	0	0	0	0
Ephemeroptera-unidentified	0	1	12	5	1	3	2
Heptogeniidae	0	0	0	5	0	0	1
Leptophlebiidae-*Paraleptophlebia*? sp	0	0	1	0	0	0	0
Plecoptera							
Leuctridae-*Leuctra* sp	0	11	0	0	0	0	0
Perlodidae	0	0	0	1	0	0	0
Plecoptera-unidentified	0	8	0	0	0	0	0
Plecoptera-pupae	0	0	0	2	0	0	0
Trichoptera							

Table 6.6-20 Total Abundance, Benthic Sampling Locations

Total Abundance of organisms from samples, Beaver Dam, Nova Scotia, June 22-24, 2016.							
Location	Watercourse NNNNN						
	4	5	13	B.a	B.b	B.c	B.d
Abundance	#	#	#	#	#	#	#
Hydropsychidae-*Diplectrona* sp	0	1	0	0	0	0	0
Hydropsychidae-*Hydropsyche* sp	0	1	1	0	0	0	0
Hydroptilidae-*Oxytheria* sp	0	0	0	1	0	1	1
Leptoceridae-*Oecetis*? sp	0	0	1	0	0	0	0
Limnephilidae *Grammotaulius*	1	0	0	0	0	0	0
Limnephilidae	0	0	0	0	0	0	1
Philopotamidae-*Chimarra* sp	1	1	1	0	0	0	0
Polycentropodidae	0	1	0	0	0	0	0
Polycentropodidae-*Polycentropus*	0	2	0	0	0	0	0
Trichoptera-unidentified	0	9	0	1	0	0	0
Odonata							
Aeshnidae-*Aesha*	0	1	3	0	0	0	0
Calopterygidae-*Calopteryx*	0	1	6	0	0	0	0
Coenagrionidae-*Argia*	0	0	1	0	0	0	0
Cordulegastridae-*Cordulegaster*	0	0	3	1	1	0	0
Odonata-unidentified	0	0	0	0	0	0	3
Megaloptera							
Corydalidae-*Chauliodes* sp	0	0	0	1	0	0	0
Corydalidae-*Nigronia* sp	0	6	1	0	0	0	0
Sialidae-*Sialis* sp	1	0	0	0	6	4	4
Collembola							
Collembola	0	0	0	1	0	1	0
Hemiptera							

Table 6.6-20 Total Abundance, Benthic Sampling Locations

Total Abundance of organisms from samples, Beaver Dam, Nova Scotia, June 22-24, 2016.							
Location	Watercourse NNNNN						
	4	5	13	B.a	B.b	B.c	B.d
Abundance	#	#	#	#	#	#	#
Corixidae	0	0	0	2	0	0	2
Gerridae	1	1	0	3	0	1	1
Hemiptera-unidentified	0	1	0	6	0	0	0
Notonectidae	0	0	0	3	0	0	0
Pleidae-*Neoplea*	0	0	0	1	0	0	0
Vellidae-*Rhagorelia*	0	0	2	0	0	0	0
Vellidae-sp. A	0	1	0	0	0	0	0
Vellidae-sp. B	0	1	0	0	0	0	0
Hirudinea							
Helobdella stagnalis	0	0	1	0	0	0	0
Hydrachnidia							
Hydrachnidia sp. A	0	0	1	0	0	0	0
Hydrachnidia sp. B	0	0	1	0	0	0	0
Hydrachnidia sp. C	0	1	0	0	0	0	0
Hydrachnidia sp. D	0	0	0	0	1	0	0
Hydrachnidia sp. E	0	0	0	0	0	0	0
Hydrachnidia sp. F	0	0	0	0	0	0	0
Hydrachnidia sp. G	0	0	0	0	0	0	0
Oligochaeta							
Oligochaete	16	4	13	1	0	0	1
Nematoda							
Nematoda	0	0	0	1	1	0	0
Mollusca							

Table 6.6-20 Total Abundance, Benthic Sampling Locations

Total Abundance of organisms from samples, Beaver Dam, Nova Scotia, June 22-24, 2016.							
Location	Watercourse NNNNN						
	4	5	13	B.a	B.b	B.c	B.d
Abundance	#	#	#	#	#	#	#
Hydrobiidae-*Amnicola limosa*?	0	0	23	0	0	0	0
Lymnaeidae-*Fossaria*? sp	0	0	1	0	0	0	0
Sphaeriidae	30	2	211	0	0	0	0
Crustacea							
Amphipoda-*Hyalella azteca*	0	0	9	0	0	0	0
Cladocera	0	0	0	24	14	16	22
Copepoda	8	48	0	0	2	0	1
Thysanoptera							
Thysanoptera-Thrip	0	0	0	0	0	0	0
Other							
Ant - terrestrial	0	0	0	0	0	1	0
Arachnida - terrestrial	0	0	0	2	0	0	1
Casts	2	5	31	56	10	20	6
SUMMARY							
Abundance (#/sample)	179	947	703	205	210	253	181
Taxon Richness	13	30	27	22	12	10	15
EPT:Total Ratio (%)	1.1	3.8	5.3	7.3	0.5	1.6	2.8
A question mark (?) after a name indicates a lack of key features to further identify organisms.							

Table 6.6-20 Total Abundance, Benthic Sampling Locations

Abundance of organisms from samples, Beaver Dam, Nova Scotia, June 22-24, 2016.							
Location	Watercourse						
	H	N	V	AA	AH	O.a	O.b
Abundance	#	#	#	#	#	#	#
Diptera							
Certapogonidae-*Probezzia/Bezzia* sp	1	0	0	8	0	0	0
Chironomidae larvae	198	60	41	494	69	88	154
Chironomidae pupae	10	1	3	16	6	7	26
Diptera adult	1	1	4	0	3	0	0
Diptera larvae	0	1	0	0	0	0	0
Empididae larvae	1	1	0	0	1	0	0
Simuliidae larvae	13	3	148	28	9	0	2
Simuliidae pupae	1	1	7	10	0	0	0
Tipulidae larvae	0	1	0	0	0	0	0
Coleoptera							
Dytiscidae adult	1	0	1	0	0	1	2
Dysticidae larvae-*Ilybius*? sp	0	0	4	0	0	0	6
Dytiscidae larvae-*Potamonectes*? sp	0	0	0	2	0	0	2
Gyrinidae? adult	0	0	1	0	0	0	0
Elmidae larvae-*Promoresia* sp	0	3	9	6	13	0	0
Elmidae larvae-*Stenelmis* sp	0	0	0	2	0	0	0
Elmidae larvae-unidentified	0	1	0	0	0	0	0
Ephemeroptera							
Baetidae	0	2	0	0	0	0	0
Ephemerellidae-*Eurylophella* sp	0	1	0	0	10	0	0
Ephemerellidae	1	0	0	6	0	0	0
Ephemeroptera-unidentified	0	1	0	8	0	10	18
Heptogeniidae	2	1	0	10	0	0	0
Heptogeniidae-*Stenonema* sp	0	0	0	0	8	0	0
Plecoptera							
Leuctridae	0	0	3	4	0	6	20
Nemouridae	3	0	16	0	0	0	0
Perlodidae	2	1	0	0	0	0	0

Table 6.6-20 Total Abundance, Benthic Sampling Locations

Abundance of organisms from samples, Beaver Dam, Nova Scotia, June 22-24, 2016.							
Location	Watercourse						
	H	N	V	AA	AH	O.a	O.b
Abundance	#	#	#	#	#	#	#
Plecoptera-unidentified	1	0	17	0	3	9	54
Plecoptera-pupae	0	0	1	0	0	2	0
Trichoptera							
Brachycentridae-*Brachycentrus*? sp	0	2	0	0	0	0	0
Brachycentridae-*Micrasema*? sp	0	0	0	4	6	0	0
Hydropsychidae-*Hydropsyche* sp	1	1	0	0	0	0	0
Hydropsychidae	0	4	0	0	0	0	0
Hydroptilidae-*Hydroptila* sp	0	10	0	0	4	0	0
Hydroptilidae-*Oxytheria* sp	0	0	0	0	0	15	86
Hydroptilidae-*Palaeaganetes* sp	0	0	0	0	0	3	2
Hydroptilidae	0	0	0	6	0	0	0
Leptoceridae-*Ceraclea* sp	0	1	0	0	0	0	0
Leptoceridae-*Oecetis*? sp	0	1	0	2	9	1	0
Leptostomatidae-*Lepidostoma* sp	2	0	7	2	5	1	10
Limnephilidae *Grammotaulius*? sp	0	0	1	0	0	0	0
Limnephilidae-sp A	0	0	0	0	0	9	8
Philopotamidae-*Chimarra* sp	0	0	0	18	3	0	0
Polycentropodidae-*Polycentropus* sp	0	0	0	0	0	2	6
Phrygeneidae?	0	0	0	0	0	1	2
Rhyacophilidae?	0	0	0	2	1	0	0
Trichoptera pupae	2	4	0	2	0	0	0
Odonata							
Aeshnidae-*Aesha* sp	0	0	0	0	0	0	2
Calopterygidae-*Calopteryx* sp	2	0	0	0	0	0	0
Coenagrionidae-*Argia* sp	0	0	0	0	1	0	0
Corduliidae	0	0	0	2	0	0	0
Megaloptera							
Corydalidae-*Nigronia* sp	0	0	0	2	0	0	0
Sialidae-*Sialis* sp	0	0	0	0	0	0	2
Collembola							

Table 6.6-20 Total Abundance, Benthic Sampling Locations

Abundance of organisms from samples, Beaver Dam, Nova Scotia, June 22-24, 2016.							
Location	Watercourse						
	H	N	V	AA	AH	O.a	O.b
Abundance	#	#	#	#	#	#	#
Collembola	16	0	11	4	0	1	2
Hemiptera							
Aphidae	0	0	0	2	0	0	0
Corixidae	0	0	0	8	0	0	0
Gerridae	9	0	1	8	0	0	0
Mesoveliidae	0	0	0	62	50	0	0
Hirudinea							
Hirundea sp A	0	0	0	2	0	0	0
Hydrachnidia							
Hydrachnidia sp. A	0	0	0	0	0	0	0
Hydrachnidia sp. B	0	0	0	0	0	0	0
Hydrachnidia sp. C	0	0	2	0	0	5	6
Hydrachnidia sp. D	0	0	0	0	0	0	0
Hydrachnidia sp. E	0	0	1	0	0	0	0
Hydrachnidia sp. F	0	0	1	0	0	0	0
Hydrachnidia sp. G	1	0	0	0	0	0	0
Oligochaeta							
Oligochaete	1	0	0	4	2	0	0
Nematoda							
Nematoda	0	0	0	0	0	0	0
Mollusca							
Sphaeriidae-*Sphaerium* sp	0	8	0	0	0	0	0
Sphaeriidae	0	0	0	6	0	0	0
Crustacea							
Cladocera	0	0	0	22	0	0	0
Copepoda	0	0	0	10	0	1	0
Thysanoptera							
Thysanoptera-Thrip	0	0	0	0	0	1	0
Other							
Arachnida - terrestrial	1	0	0	0	0	0	0

Table 6.6-20 Total Abundance, Benthic Sampling Locations

Abundance of organisms from samples, Beaver Dam, Nova Scotia, June 22-24, 2016.							
Location	Watercourse						
	H	N	V	AA	AH	O.a	O.b
Abundance	#	#	#	#	#	#	#
Casts	22	0	10	6	0	2	0
SUMMARY							
Abundance (#/sample)	269	110	279	762	203	163	410
Taxon Richness	21	23	20	31	18	18	19
EPT:Total Ratio (%)	5.2	26.4	16.1	8.4	24.1	36.2	50.2
A question mark (?) after a name indicates a lack of key features to further identify organisms.							

Taxon richness indicates the health of the community through its diversity, and increases with increasing habitat diversity, suitability, and water quality. Taxon richness equals the total number of taxa represented within the sample. The healthier the community is, the greater the number of taxa found within that community. Similarly, a high abundance may indicate a healthier waterbody.

The EPT index is named for three orders of pollution sensitive aquatic insects that are common in the benthic macroinvertebrate community: Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) and is commonly used as an indicator of water quality (i.e., the greater percentage of the total sample comprised of EPT organisms indicates a healthier site). Generally speaking, the EPT index increases with increasing water quality. However, there are many factors that regulate the distribution and abundance of benthic macroinvertebrates within aquatic environments (as well as biological condition within a waterbody), thus the results of this study only allow for the establishment of baseline conditions that can later be used in a monitoring program to identify potential changes to water quality within these specific environments.

As previously mentioned, there are several factors that regulate the distribution and abundance of benthic macroinvertebrates, including current speeds, temperature, altitude, season, substratum, vegetation, dissolved substances (e.g., oxygen), and pH (Hussain & Pandit, 2012). In order to illustrate the effects of some of these factors, temperature and pH will be discussed in relation to their effects on benthic macroinvertebrates.

The distribution and community structure of benthic macroinvertebrates is limited by their ability to live within a specific temperature range. Temperature affects their emergence patterns, growth rates (Sweeney & Schnack, 1977), metabolism (Angelier, 2003), reproduction (Vannote & Sweeney, 1980), and body size (Sweeney & Schnack, 1977).

Benthic macroinvertebrates vary in their sensitivity to pH (i.e., values below 5.0 and greater than 9.0 are considered harmful) (Yuan, 2004). However, studies have shown that low pH values are associated with lower diversity of benthic macroinvertebrates (Thomsen & Friberg, 2002), and cause decreased emergence rates in them (Hall, Likens, Fiance, & Hendrey, 1980), for example.

Overall abundance and taxon richness within PA watercourses were low to moderate (110-947 individuals/sample and 10-31 taxon, respectively), and EPT ratios low at eight of the sites (0.5-8.4%) and moderate (16.1-50.2%) at the remaining sites (Watercourse N, V, AH, O). The occurrence of Mollusca at some of the sites, in addition to the EPT groups (Trichoptera, Ephemeroptera and Plecoptera) at most sites suggests that dissolved oxygen and water quality is acceptable, as these groups generally are associated with aquatic habitat having good water quality.

6.6.4 Consideration of Consultation and Engagement Results

Key issues raised during public consultation and Mi'kmaq engagement relating to fish and fish habitat include potential indirect effects from wetland alteration or changes to surface water and groundwater quality and quantity on fish and fish habitat. A high value was placed on fish and fish habitat in the receiving waters based on engagement with stakeholders and the Mi'kmaq of Nova Scotia.

The results of the public consultation and Mi'kmaq engagement have been considered in the environmental effects assessment, including the Proponent's commitments on mitigation and monitoring measures and proposed compliance and effects monitoring programs, as well as the Proponent's broader commitment to ongoing public consultation and Mi'kmaq engagement. Specific to evaluating the effect on fish and fish habitat, these are found within the following environmental effects assessment.

6.6.5 Effects Assessment Methodology

6.6.5.1 Boundaries

Spatial Boundaries

The spatial boundaries used for the assessment of effects to fish and fish habitat are the Project areas for the mine footprint and the haul road, and the LAA consisting of surface water systems immediately adjacent to and receiving drainage from the PAs, within each affected tertiary watershed (seven along haul road PA and three within the mine footprint PA).

Temporal Boundaries

The temporal boundaries used for the assessment of effects to fish and fish habitat are the construction phase, operational phase, and decommissioning and reclamation phase.

Technical Boundaries

No technical boundaries were identified for the effects assessment of fish and fish habitat.

Administrative Boundaries

The Project Team evaluated fish and fish habitat for the Beaver Dam Mine within the framework offered by the Fisheries Act (1985) and supporting policy statements and documents from Fisheries and Oceans Canada, including those referenced herein. DFO interpretation of serious harm to fish and species of CAR interest support the evaluation of this Valued Component for the purpose of this EIS.

6.6.5.2 Thresholds for Determination of Significance

A significant adverse effect from the Project on fish and fish habitat is defined as an effect that is likely to cause serious harm to fish, as defined by the Government of Canada (1985, Section 2(1)):

"serious harm to fish is the death of fish or any permanent alteration to, or destruction of, fish habitat," with fish habitat defined as "spawning grounds and any other areas, including nursery, rearing, food supply and migration areas, on which fish depend directly or indirectly in order to carry out their life processes."

An adverse effect that does not cause a permanent loss to fish or fish habitat is considered to be not significant. Alternatively, an adverse effect that does cause a permanent loss to fish habitat may be mitigated by replacement of lost habitat and removal/rescue of fish present prior to commencement of the activity. This may also allow for an adverse effect to be considered not significant.

6.6.6 Project Activities and Fish and Fish Habitat Interactions and Effects

Table 6.6-21 Potential Fish and Fish Habitat Interactions with Project Activities at Beaver Dam Mine Site

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Clearing, grubbing, and grading in preparation of construction • Rock blasting in preparation of construction • Till and waste rock from site preparation transport and storage • Existing settling pond dewatering in preparation of construction • Watercourse and wetland alteration in preparation of construction • Mine site road construction • Surface infrastructure installation and construction • Collection and settling pond construction • Environmental monitoring of surface water discharges and fish and fish habitat • General management of wastes derived from preparation and construction activities • Accidents and malfunctions to include fuel and other spills, forest fires, settling pond overflow, slope failure, an unplanned explosive event, and a mobile equipment accident
Operation and Maintenance	3-4 years	• Rock blasting to access and extract ore • Surface mine dewatering to facilitate access to and extraction of ore • Management of waste rock produced from crushing and preparing ore for transport • Treatment of site surface water runoff and surface mine pumped water

Project Phase	Duration	Relevant Project Activity
		• Petroleum products management • Environmental monitoring of surface water discharges and fish and fish habitat • General management of wastes derived from operation and maintenance activities • Accidents and malfunctions to include fuel and other spills, forest fires, settling pond overflow, slope failure, an unplanned explosive event, and a mobile equipment accident
Decommissioning and Reclamation	1-2 years	• Site reclamation activities • Environmental monitoring of surface water discharges • General management of wastes derived from decommissioning and reclamation activities • Accidents and malfunctions to include fuel and other spills, forest fires, and a mobile equipment accident

Table 6.6-22 Potential Fish and Fish Habitat Interactions with Project Activities along Haul Road

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Clearing, grubbing, and grading in preparation of construction • Rock blasting in preparation of construction • Till and waste rock from site preparation transport and storage • Watercourse and wetland alteration in preparation of construction • Haul road construction and upgrades and new culvert installation • Culvert removal along current road where possible to re-establish fish passage (where hung or crushed culverts are present) • Environmental monitoring of surface water • General management of wastes derived from preparation and construction activities • Accidents and malfunctions to include fuel and other spills, forest fires, and a haul truck accident
Operation and Maintenance	3-4 years	• Haul road maintenance and repairs • Environmental monitoring of surface water • Accidents and malfunctions to include fuel and other spills, forest fires, and a haul truck accident
Decommissioning and Reclamation		N/A[1]
1 Decommissioning and Reclamation of the Haul Road is not expected. The haul road will be returned to owner for forestry industry		

Table 6.6-23 Potential Fish and Fish Habitat Interactions with Project Activities at Touquoy Processing and Tailings Management Facility

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Accidents and malfunctions to include fuel and other spills, forest fires, and mobile equipment accidents
Operation and Maintenance	3-4 years	• Management of tailings produced from processing ore • Environmental monitoring of surface water and fish and fish habitat • General management of waste derived from processing activities • Accidents and malfunctions to include fuel and other spills, forest fires, and a haul truck accident
Decommissioning and Reclamation	1-2 years	• Environmental monitoring of surface water and fish and fish habitat • Accidents and malfunctions to include fuel and other spills, and forest fires

Development of the Beaver Dam mine site will cause direct impacts to fish and fish habitat mostly within the construction phase of the Project during clearing, grubbing, blasting and development of the mine and open pit and its associated infrastructure.

Continuing impacts to fish and fish habitat are possible during operations of the mine from on-going dewatering efforts within the open pit, and potential siltation and release of substances to downstream receiving surface water systems adjacent to the mine infrastructure.

Construction of the haul road may cause impacts to fish and fish habitat mostly within the construction phase of the Project during clearing, grubbing and construction of new road components and road widening where necessary. During construction, positive direct impacts to fish and fish habitat are also expected where current culverts that are hung or crushed can be either replaced or removed and fish passage and habitat re-established.

The Touquoy facility is currently under construction. Potential impacts to surface water quality as a result of the storage of Beaver Dam tailings in the exhausted Touquoy open pit mine were examined, but it should be noted that these are restricted to the surface water in the exhausted pit only. The flooded pit will be a lake setting physically disconnected from other nearby natural surface water bodies. Due to this disconnection, potential for direct or indirect effects to fish or fish habitat are not anticipated due to the processing of ore and the management of tailings from the Beaver Dam Mine Project. The use of the Touquoy facility for the processing of Beaver Dam ore will not involve construction, alteration of fish or fish habitat, or discharge of effluent into surface water bodies; therefore, no effects are anticipated at the Touquoy facility related to the processing of Beaver Dam ore, with the exception of the continued potential for accidents and malfunctions and continued environmental monitoring.

Table 6.6-24 Direct and Indirect Impacts to Fish and Fish Habitat

Impact Type	Direct Impact	Project Phase1	Indirect Impact	Project Phase1
Fish Mortality	Loss of habitat within mine footprint (removal of wetland or watercourse) to support mine development could result in mortality to fish for various species and life stage	C	N/A	N/A
Changes in composition and characteristics of fish populations	N/A	N/A	Loss of watercourse and/or wetland habitat or indirect operational impacts within the mine footprint may result in fish population changes including composition and characteristics of various fish species	C
Modification in Migration or local movements of fish	N/A	N/A	Construction of barriers (physical or hydraulic) within mine footprint or haul road resulting in a change in migration or local movements of fish	C
Reduction in Fish Populations	Potential for the increase in commercial fishing activities within the Project footprint as a result of increased access	O	N/A	N/A
Vibrations from Blasting	Vibrations from blasting activities within the mine footprint could affect fish behaviour, spawning and migration.	C O	Blasting adjacent to wetlands and watercourses has the potential to alter surface and/or subsurface water flows, especially in fractured rock. This activity has the potential to increase, or decrease hydrological flow to adjacent and downstream surface water systems and can hence precipitate drying (dewatering) or wetter conditions in those habitats affecting fish habitat.	
Alteration of Fish Habitat (Hydrology): If the hydrological regime of a wetland or watercourse (wc) is altered, fish habitat can be negatively affected (reduction or severe increase in water)	Complete dewatering (removing wetland or watercourse), infilling or flooding of a wetland or wc to facilitate Project development resulting in direct loss of fish habitat	C	Hydrologically connected up-stream wetlands or watercourses and associated fish habitat may also be at risk of in-direct impacts as a result of down-stream alteration activities (i.e. water outflow changes, land elevation changes, blasting etc. causing dewatering). In-advertent damming of up-gradient wetlands or watercourses from construction related infrastructure (i.e. roads with lack of flow through infrastructure) can also affect downstream fish habitat. Changes in surface hydrology can impact downstream water quantity which can affect fish habitat	C D
	Alteration of hydrological inputs and outputs into partially altered wetlands or	C D	Removal of on-site watercourses or outflow and throughflow wetland habitat has the potential to alter the localized hydrology in down-gradient surface water systems and associated fish habitat.	C

Table 6.6-24 Direct and Indirect Impacts to Fish and Fish Habitat

Impact Type	Direct Impact	Project Phase1	Indirect Impact	Project Phase1
	wc has the potential to alter remaining (undeveloped) associated fish habitat.		Hydrological changes can impact the use of a wetland or wc by fish and other aquatic organisms as a habitat resource.	C
			Blasting and pumping adjacent to wetlands and watercourses has the potential to alter surface and/or subsurface water flows, especially in fractured rock. This activity has the potential to increase, or decrease hydrological flow to adjacent and downstream surface water systems and can hence precipitate drying (dewatering) or wetter conditions in those habitats affecting fish habitat.	C
Alteration of Water Quality:	Removal (alteration) of wetland from the landscape leading to a change in water quality in down-gradient aquatic receivers (i.e. streams, additional wetlands and lakes) resulting in an adverse change to fish or fish habitat.	C D	Alteration of wetlands or watercourses increases the risk of down grade sedimentation which would affect fish and fish habitat	C/O/D
			The effect of increased sedimentation as a result of up-gradient activities (i.e., earth moving, removal of vegetation, soil stockpiling) has the capacity to suffocate existing plant life and increase nutrient levels in downgrade surface water systems. Dust created as a result of construction activities can have a similar impact.	C D
			Runoff from acid producing rock exposed during construction activities has the potential for negatively altering water quality within down-gradient fish habitat.	C D
Malfunctions and Accidents: Accidental spills of contaminants in up-grade work areas has the potential to drain into down-gradient surface water systems and associated fish habitat, and can cause negative impact to fish and fish habitat.				C O D

Expected and potential direct fish and fish habitat impacts to surface water features (wetlands and watercourses) in the immediate vicinity of the PA as a result of the Project construction and development within the mine footprint are described in Table 6.6-24 below. Broader potential indirect impacts to down-gradient watershed water quality and quantity within the LAA are described in Section 6.3.8 and effects are evaluated within that section. Maintaining water quality and quantity downstream in the LAA is paramount for limiting broader fish and fish habitat impacts within each affected watershed associated with the Beaver Dam Mine footprint and haul road PA.

Fish and Fish Habitat Impact Extent

Expected impact extent as a result of Project activities during the temporal lifetime of the mine are described in Table 6.6-24. Some impacts are confirmed (meaning fish are present), based on electrofishing and other survey results, and some impacts are identified as potential impacts, based on connectivity to surface water that supports fish. At these locations with potential impacts, fish were not observed during on-site surveys. Further work to understand potential fish habitat and fish presence at specific alteration locations will be required to support surface water permitting (wetlands and watercourse alteration). Mitigation will be implemented to reduce the potential for direct fish mortality where fish were observed through fish rescue efforts prior to commencement of construction and completion of relevant construction activities within confirmed fish habitat within approved timing windows for construction (June 1 to Sept 30) to reduce potential for mortality of eggs and juvenile fish.

Site specific detailed information (such as habitat quality and quantity, permanent or temporary impacts) will be included in permitting applications in order for DFO to determine the level of risk and potential permitting requirements related to project impacts. These could include the need for a *Fisheries Act* authorization and the requirement for offsetting. There will be opportunities to further redesign the project to avoid/minimize the impacts.

The following potential impact extents are included:

- P – Partial expected fish habitat loss
- C – Complete expected fish habitat loss

Table 6.6-25 Potential Direct and Indirect Fish and Fish Habitat Impacts within the Mine Footprint PA

Surface Water Feature (wetland or w)	Mine Infrastructure	Fish Habitat Present (CAR species)	Direct Impact Type	Potential or Confirmed Impact to Fish (m^2)
Wetland 17	Open Pit	**Potential** (based on electrofishing results in WC5 and associated Mud Lake)	P	7,730.4
Wetland 56	Open Pit	**Confirmed** (electrofishing)	C	16,274.9
Wetland 59	Open Pit	**Confirmed** (fish observed during site surveys)	P	64,605.4
Wetland 61	Open Pit	**Potential** (based on electrofishing results in WC13 and associated Cameron Flowage)	P	1,229.1

Table 6.6-25 Potential Direct and Indirect Fish and Fish Habitat Impacts within the Mine Footprint PA

Surface Water Feature (wetland or w)	Mine Infrastructure	Fish Habitat Present (CAR species)	Direct Impact Type	Potential or Confirmed Impact to Fish (m^2)
Watercourse 12	Open Pit	**Confirmed** (electrofishing)	C	467.5
Watercourse 13	Open Pit	**Confirmed** (electrofishing)	C	237.5
Wetland 13	Waste Rock Storage	**Low potential** for fish to this upper reach of WC4 but possible	C	4,815.8
Wetland 29	Waste Rock Storage	**Potential** fish habitat but not confirmed in this system	P	39,222.8
Wetland 33	Waste Rock Storage	**Low potential** for fish to this upper reach of WC11	P	1,899.9
Wetland 44	Waste Rock Storage	**Potential** (beaver flowage impoundment and confirmed fish habitat directly north and downgradient in WL8 and Crusher Lake	C	10,610.9
Wetland 46	Waste Rock Storage	**Low potential** for fish to this upper reach of WC5	C	753.8
Wetland 52	Waste Rock Storage		C	1,619.9
Wetland 53	Waste Rock Storage		C	824.2
Wetland 48	Waste Rock Storage	**Low potential** for fish to this upper reach of WC4	C	2,876.1
Watercourse 4	Waste Rock Storage	**Potential** (based on electrofishing results in lower reaches of WC4)	P	201.4
Watercourse 5	Waste Rock Storage	**Potential** (based on electrofishing results in lower reaches of WC5)	P	432.7
Watercourse 11	Waste Rock Storage	**Potential** (based on electrofishing results in lower reaches of WC4)	P	589.8
Wetland 20	Stockpiles	**Low potential** (no fish observed in WC3 during electrofishing)	C	10,104.6
Wetland 14	Stockpiles	**Potential** fish habitat (based on electrofishing results in WC5)	P	3,348.6
Wetland 8	Stockpiles	**Potential** fish habitat (based on electrofishing results in WC5 and fish collection in Crusher Lake)	P	1,835.2
Watercourse 3	Stockpiles	**Potential** (based on electrofishing results in lower reaches of WC5)	P	120.96

Table 6.6-25 Potential Direct and Indirect Fish and Fish Habitat Impacts within the Mine Footprint PA

Surface Water Feature (wetland or w)	Mine Infrastructure	Fish Habitat Present (CAR species)	Direct Impact Type	Potential or Confirmed Impact to Fish (m^2)
Wetland 57	Facilities/ROM Pad/Roads	**Low potential** for fish to this upper reach of WC14 and into the wetland habitat.	P	19,396.5

As outlined in Table 6.6-25, two wetlands and two watercourses will be directly impacted by the mine development and are confirmed to support fish and fish habitat (Wetlands 56 and 59 and Watercourses 12 and 13). These impacts are all related to the development of the open pit area and impacts are expected to be permanent. As part of the open pit development, the connectivity between Wetland 56/59 and Cameron Flowage through Watercourse 13 will be removed. During operations of the mine, no direct connectivity between the pit and Cameron Flowage will be present. During decommissioning, the pit will be filled with water, creating a lake. The current plan does not include re-establishing a connection between this lake and Cameron Flowage. However, during permitting and also during the development of the reclamation plan, consultation with DFO will be completed to review this connectivity and the long term plan for the lake and Cameron Flowage.

All other wetlands and watercourses included in Table 6.6-25 could potentially support fish, but no fish were observed during electrofishing surveys in wetlands or associated watercourses. These potential impacts to fish habitat (defined as Low Potential or Potential) are associated with the development of the waste rock pile, stockpiles and facilities to support the mine. Further detailed surveys will be required during permitting to confirm fish habitat potential within specific alteration areas within each wetland and watercourses listed in Table 6.6-25.

Eight wetlands and two watercourses that potentially or have been confirmed to support fish habitat will be completely altered (direct footprint impact). Eight wetlands and three watercourses that potentially or have been confirmed to support fish habitat will be partially altered (direct impact) as a result of mining activities and associated infrastructure associated with the mine footprint PA.

Mortality to fish is expected to be low, once mitigation measures are implemented including fish rescue of adult fish prior to commencement of construction activities in confirmed fish habitat and adherence to approved timing windows for construction to minimize impact to eggs, larvae, and juvenile fish. Direct alteration within the mine footprint is limited to first order streams that have limited potential to support spawning. As a result, work associated with development of the mine will not affect migration patterns or local movements of fish species, and there is no expectation of change to the composition of populations of fish, given the limited numbers of fish observed within the mine footprint and its position in the landscape (first order streams). Furthermore, the three waterbodies present within the mine footprint will be avoided during Project development, limiting impact to fish populations present in these larger more significant systems (especially Cameron Flowage). The most significant watercourse draining from Crusher Lake to Mud Lake has also been avoided during Project design planning. The mine footprint PA will not be publically accessible, so there is no expectation of an increase in commercial fishing activity as a result of this Project development.

Direct impacts to fish and indirect impacts to fish behavior, spawning grounds and migration patterns are possible from blasting activities associated with mine development. The detonation of explosives near watercourses within the Project Area can produce post-detonation shock waves which involves a rise to a high peak pressure and then a subsequent fall to below ambient hydrostatic pressure. This pressure deficit can cause impacts in fish (Wright and Hopky, 1998). An overpressure in excess of 100 kPa can result in effects in fish including damage to the swimbladder in finfish, and potential rupture and hemmorage to the kidney, liver, spleen and sinus venous. It is also possible that fish eggs and larvae can be damaged (Wright and Hopky, 1998). The degree of damage is related to the type of explosive, size and pattern of the charges and the distance to the watercourse, depth of water within the watercourse, and species, size and life stage of the fish.

Sublethal effects have also been observed including changes in fish behavior on several occasions as a result of noise produced during blasting (Wright and Hopky, 1998). Setback recommendations and other mitigation strategies to minimize impact to fish and fish habitat from blasting activities outlined in Wright and Hopky will be adhered to during the development of the Beaver Dam Mine.

Expected and potential direct fish and fish habitat impacts to surface water features (wetlands and watercourses) in the immediate vicinity of the PA as a result of the Project construction and development within the haul road PA are described in Table 6.6-25 below. Potential indirect impacts to fish and fish habitat within the PA are expected to be similar across all locations where the proposed road infrastructure intersects with surface water systems and will be minimized by standard construction and mitigation techniques.

Maintaining water quality and quantity downstream in the PA and LAA is paramount for limiting broader fish and fish habitat impacts within each affected watershed associated with the Beaver Dam Mine haul road PA. However, indirect impacts to down-gradient watershed water quality and quantity within the PA and LAA that may affect fish and fish habitat are not expected from the road infrastructure (re-alignment and widening) once standard construction methods for culvert installation and mitigation strategies are implemented during road widening and re-alignment.

Table 6.6-26 Potential Direct Fish and Fish Habitat Impacts within the Haul Road PA

Surface Water Feature (wetland)	Fish Habitat Present (CAR species)	Direct Impact Type	Potential or Confirmed Impact to Fish (m^2)
Wetland 66	**Potential** fish habitat	P	783.3
Wetland 73	**Potential** fish habitat	P	1570.4
Wetland 74	**Potential** fish habitat	P	344.4
Wetland 76	**Potential** fish habitat	P	229.1
Wetland 79	**Potential** fish habitat	P	303.1
Wetland 94	**Potential** fish habitat	P	274.8
Wetland 146	**Potential** fish habitat	P	199.4
Wetland 154	**Potential** fish habitat	P	120.4
Wetland 159	**Confirmed** fish habitat (electrofishing at WC AA)	P	204.3

Potential direct impacts to fish habitat within watercourses along the haul road are assumed to be limited based on standard crossing construction to mitigate any impacts to fish (culverts, open bottom box culverts, bridges). More significant impacts may be possible if road alignment doesn't allow for perpendicular crossings. However, these details won't be fully understood until detailed design of the upgraded road is completed (permitting stage).

As outlined in Table 6.3-25, nine wetlands that are expected or confirmed to support fish habitat will be partially altered within the haul road PA to support road upgrades, widening and re-alignment as required. One wetland is known to support fish (Wetland 159) based on direct connectivity with Watercourse AA. The rest of the wetlands have been identified as potential fish habitat only. Additional surveys will be required during permitting to confirm fish habitat potential at each specific alteration locations.

Limited indirect impacts are expected, once standard construction methods for culvert installation and mitigation strategies are implemented during road widening and re-alignment. Road construction will allow for a clear porous subgrade or cross drainage culverts in order for wetland hydrology to be maintained post-construction. Culverts will be installed in accordance with DFO and NSE guidance to reduce potential impacts to fish and fish habitat. Where appropriate, AG will work to install open bottom box culverts to reduce potential impact on the watercourses and associated fish habitat during road construction.

Potential hydrological and water quality related in-direct impact types are also anticipated in the mine footprint and haul road PA. In addition, due to the nature of proposed activities (i.e. active construction site, presence of vehicles and construction equipment throughout), all fish habitat identified within the PA have potential to be indirectly impacted as a result of accidents and malfunctions and vegetative and habitat impacts (i.e. invasives, vegetation removal etc.). Mechanisms to reduce the potential for vegetative and habitat impacts from accidents and malfunctions will be addressed and discussed in Section 6.15.

Potential for down-gradient, in-direct fish and fish habitat impacts could occur throughout the mine footprint PA as a result of up-gradient hydrological alteration. Primarily, the alteration of hydrological conditions in up-gradient wetlands and watercourses could affect natural inflows, outflows and hydroperiod characteristics in contiguous wetland and watercourse systems where fish habitat is present. In addition, where up-gradient alteration is occurring, but a direct hydrological flow is being maintained, potential exists for in-direct impacts to down-gradient water quality conditions.

Within the mine footprint PA, areas of heightened risk of these in-direct impact types to fish and fish habitat include wetlands (and associated watercourses) bordering Crusher Lake (e.g. Wetlands 4, 8, 10, 11, WC4 and WC5) and Crusher Lake itself due to them directly receiving water from up gradient wetlands and watercourses which are subject to alteration (i.e. headwater and throughflow wetlands and associated watercourses). Similarly, Wetlands 20, 14 and 17, all of which act as throughflow wetlands that intercept water prior to it draining into Mud Lake, and Mud Lake itself, are also at potential risk of in-direct hydrological and water quality impacts as a result of up-gradient alteration activities. At the eastern extent of the mine site PA, alteration to Wetland 57, a headwater wetland, has the potential to in-directly impact its down-gradient aquatic receptors and fish habitat which include Watercourse 14, the eastern extent of Wetland 59, Wetland 61 and Cameron Flowage. At the southern extent of the mine site PA, alteration to Wetland 29 has the potential to in-directly impact lower lying portions of the same wetland system and headwater stream system, as it extends beyond the southern mine footprint PA boundary.

Potential also exists for up-gradient hydrological alteration as a result of down-gradient hydrological alteration. Examples include altered outflow (i.e. faster or slower outflows due to mine site drainage infrastructure), causing either dewatering (drying hydrological trend) or flooding conditions in up-gradient wetlands that support fish.

The potential for in-direct fish and fish habitat impacts as a result of upgrading and new construction of the proposed haul road also exists. However, due to the limited alteration footprint to up-gradient wetlands from haul road infrastructure, and mitigation methods that will be employed as part of the construction process, down-gradient, in-direct impacts are not expected. As is consistent with alteration to all surface water systems associated with the Project, protection and viability of connected, unaltered areas of surface water and associated fish habitat are considered as part of the provincial and federal permitting for wetlands and watercourses. Design of suitable hydrological connectivity structures (i.e. culverts), the implementation of a Project EPP, and ESC methods will be employed to ensure that indirect impacts to upstream or downstream surface water and fish habitat will not occur as a result of the activities associated with the haul road. In addition, however, post construction monitoring will be performed at alteration locations as discussed in Section 6.6.7 to ensure this expectation.

Widening and upgrade efforts to the haul road will require a combination of new culverts where new sections of road are required, and replacement of culverts where road upgrades and/or widening is required to support Project development. During evaluation of culverts within the haul road PA in 2015 and 2016, many culverts along the haul road were observed to be in disrepair. The Beaver Dam Mine Project will allow for re-installation of many culverts to replace those that are currently present that are installed improperly (hung or buried), or that have deteriorated (crushed), where appropriate. Table 6.6-26 describes each watercourse crossing within the haul road PA and the current condition of the culvert where applicable, and the general plan for upgrading each crossing during Project construction. This table also provides a general commentary on the effect on fish habitat during culvert upgrades and installation of new culverts.

Site specific detailed information (such as habitat quality and quantity, permanent or temporary impacts) will be included in permitting applications in order for DFO to determine the level of risk and potential permitting requirements related to project impacts. These could include the need for a *Fisheries Act* authorization and the requirement for offsetting. There will be opportunities to further redesign the project to avoid/minimize the impacts.

Table 6.6-27 Watercourse Locations within Haul Road PA and Culvert Condition and Plan for Upgrade

Watercourse Location	Current Crossing and Condition	Plan for Upgraded Haul Road	Estimated Direct Impacts to Confirmed or Potential Fish Habitat
WC A	buried	improvement - remove buried culvert and replace with new at same location	Proposed upgraded road alignment perpendicular to wc. Replace buried culvert. Standard mitigation will apply to limit impact to fish habitat and overall improve fish habitat through removal of buried culvert. No direct impact expected to watercourse footprint
WC B	crushed	improvement - new culvert and removal of crushed culvert along existing road	Proposed upgraded road alignment perpendicular to wc. Remove crushed culvert and install new culvert upstream at new crossing location. Standard mitigation will apply to limit impact to fish habitat and overall improve fish habitat through removal of crushed culvert. No direct impact expected to watercourse footprint
WC C	functioning	net zero - new culvert. Functioning culvert along existing road can stay	Proposed upgraded road alignment perpendicular to wc. Existing culvert can remain. Install new culvert upstream at new crossing location. Standard mitigation will apply to limit impact to fish habitat. No direct impact expected to watercourse footprint.
WC D	no culvert	net zero - new culvert	Proposed upgraded road alignment perpendicular to wc. Install new culvert at new crossing location. Standard mitigation will apply to limit impact to fish habitat. No direct impact expected to watercourse footprints.
WC E	blocked	improvement - new culvert and removal of debris/barrier along existing road	Proposed upgraded road alignment perpendicular to wc. Remove blocked culvert and install new culvert downstream at new crossing location. Standard mitigation will apply to limit impact to fish habitat and overall improve fish habitat through removal of crushed culvert. A short inlet tributary to WC-E may be altered by haul road upgrades Total Linear Length 29.3 m; Total Area 52.7 m^2.
WC F	crushed	improvement - new culvert and removal of one hung and one collapsed culvert along existing road	Proposed upgraded road not fully perpendicular to wc. WC travels along length of proposed road for 29.2 m. This short length of watercourse may be altered by haul road upgrades resulting in alteration of fish habitat. Total Area 49.6 m^2.
WC G	crushed	improvement - new culvert and removal of crushed culvert along existing road	Proposed upgraded road alignment perpendicular to wc. Remove crushed culvert and install new culvert just upstream at new crossing location. Standard mitigation will apply to limit impact to fish habitat and overall

Table 6.6-27 Watercourse Locations within Haul Road PA and Culvert Condition and Plan for Upgrade

Watercourse Location	Current Crossing and Condition	Plan for Upgraded Haul Road	Estimated Direct Impacts to Confirmed or Potential Fish Habitat
			improve fish habitat through removal of crushed culvert. No direct impact expected to watercourse footprint
WC H	bridge- no barrier	net zero - new bridge (or culvert)	Proposed upgraded road alignment will allow for new bridge (or culvert) to be installed downstream of current crossing. Standard mitigation will apply to limit impact to fish habitat. No direct impact expected to watercourse footprint.
WC I	buried	improvement - new culvert and removal of buried culvert along existing road	Proposed upgraded road alignment will allow for these two watercourses to join and be culverted under the new road together at this location. Removal of two buried culverts and installation of a new culvert will result in an improvement to fish habitat. Standard mitigation will apply to limit impact to fish habitat and no direct impact is expected to watercourse footprint
WC J	buried	improvement - new culvert and removal of buried culvert along existing road	
WC K	no culvert	net zero - new culvert	Proposed upgraded road alignment is not perpendicular to wc. However, the upgraded road is proposed to align with current road at this location. There is no culvert present. Installation of a new culvert with widened road will result in improvement in fish habitat. Standard mitigation will apply to limit impact to fish habitat.
WC L	functioning	net zero - new culvert. Functioning culvert along existing road can stay	Wc runs parallel to the current road in a roadside ditch. Proposed road upgrade will allow for a new culvert installation to funnel the wc directly across the road to the east side and away from the ditch network associated with the road. Standard mitigation will apply to limit impact to fish habitat. Total Area of 89.0 m^2 of watercourse (as ditch) will be removed during road upgrades
WC M	functioning	net zero - culvert extension to support widening efforts	Proposed upgraded road alignment is perpendicular to wc and will require an extension to existing culvert which is functioning well. Standard mitigation will apply to limit impact to fish habitat. No direct impact to fish habitat expected to watercourse footprint
WC N- West River	bridge	net zero - upgrade of bridge	Proposed upgraded road alignment will allow for upgraded bridge at current crossing location. Standard mitigation will apply to limit impact to fish habitat. No direct impact expected to watercourse footprint.

Table 6.6-27 Watercourse Locations within Haul Road PA and Culvert Condition and Plan for Upgrade

Watercourse Location	Current Crossing and Condition	Plan for Upgraded Haul Road	Estimated Direct Impacts to Confirmed or Potential Fish Habitat
WC O	no culvert	net zero - new culvert	Proposed new road will be designed to run perpendicular to the wc. Standard mitigation will apply to limit impact to fish habitat. No direct impact expected to watercourse footprint
WC P	no culvert	n/a	Proposed new road does not overlap with wc
WC Q	no culvert	n/a	Proposed new road does not overlap with wc
WC R	no culvert	n/a	Proposed new road does not overlap with wc
WC S	hung	improvement - new culvert and removal of hung culvert along existing road	Proposed upgraded road alignment perpendicular to wc. Replace hung culvert. Standard mitigation will apply to limit impact to fish habitat and overall improve fish habitat through removal of hung culvert. No direct impact expected to watercourse footprint
WC T	buried	improvement - remove buried culvert and replace with new at same location	Proposed upgraded road alignment perpendicular to wc. Replace buried culvert. Standard mitigation will apply to limit impact to fish habitat and overall improve fish habitat through removal of buried culvert. No direct impact expected to watercourse footprint
WC U	functioning	culvert extension to support widening efforts	Proposed upgraded road not fully perpendicular to wc. WC travels along length of proposed road for 17.3 m. This short length of watercourse may be altered by haul road upgrades resulting in alteration of fish habitat. Total Area 17.3 m^2.
WC V	buried	improvement - new culvert and removal of hung/buried culvert along existing road	Proposed upgraded road alignment perpendicular to wc. Replace buried culvert. Standard mitigation will apply to limit impact to fish habitat and overall improve fish habitat through removal of buried culvert. No direct impact expected to watercourse footprint
WC W	hung	improvement - new culvert and removal of hung culvert along existing road	Proposed upgraded road alignment perpendicular to wc. Replace hung culvert. Standard mitigation will apply to limit impact to fish habitat and overall improve fish habitat through removal of hung culvert. No direct impact expected to watercourse footprint
WC X	no culvert	net zero - new culvert	Proposed upgraded road alignment is perpendicular to wc and will require a new culvert installation. Standard mitigation will apply to limit impact to fish habitat. No direct impact expected to watercourse footprint.
WC Y	no culvert	net zero - new culvert	Proposed upgraded road alignment is perpendicular to wc and will require a new culvert installation. Standard mitigation will apply to limit impact to fish habitat. No direct impact expected to watercourse footprint.

Table 6.6-27 Watercourse Locations within Haul Road PA and Culvert Condition and Plan for Upgrade

Watercourse Location	Current Crossing and Condition	Plan for Upgraded Haul Road	Estimated Direct Impacts to Confirmed or Potential Fish Habitat
WC Z	buried	net benefit - re-establish wetland hydrology	Proposed new road does not overlap with wc. However, culvert present at wetland crossing is buried and re-installment of a new culvert will re-establish proper hydrologic connection for wetland habitat.
WC AA	hung	improvement - new culvert and removal of hung culvert along existing road	Proposed upgraded road alignment perpendicular to wc. Replace hung culvert. Standard mitigation will apply to limit impact to fish habitat and overall improve fish habitat through removal of hung culvert. No direct impact expected to watercourse footprint
WC AB	no culvert	net zero to wc - wetland impacts only	Proposed upgraded road alignment does not overlap with wc.
WC AC	no culvert	net zero to wc - wetland impacts only	Proposed upgraded road alignment does not overlap with wc.
WC AD-Morgan River	bridge	net zero - upgrade of bridge	Proposed upgraded road alignment will allow for upgraded bridge at current crossing location. Standard mitigation will apply to limit impact to fish habitat. No direct impact expected to watercourse footprint.
WC AE	buried	improvement - new culvert and removal of buried culvert along existing road	Proposed upgraded road alignment perpendicular to wc. Replace buried culvert. Standard mitigation will apply to limit impact to fish habitat and overall improve fish habitat through removal of buried culvert. No direct impact expected to watercourse footprint
WC AF	no culvert	n/a	Proposed new road does not overlap with wc
WC AG	no culvert	n/a	Proposed upgraded road alignment overlaps with the top end of this watercourse. A total area of 2.9 m^2 may be altered to support road upgrades. Standard mitigation will apply to limit impact to fish habitat.
WC AH	no culvert	n/a	Proposed new road does not overlap with wc

Along the existing haul road at locations where the proposed road upgrade alignment will fall, the current summary of culvert conditions is as follows: 7 buried, 3 crushed, 1 blocked, 3 hung, 3 operating bridges, 4 functioning culverts, 4 locations with no culvert - new required, 8 locations with no culvert - none required as the watercourse doesn't fall within proposed alignment for upgraded road. During construction and upgrades of the haul road necessary to support the Beaver Dam Mine Project, the Project team anticipates that there will be up to 13 opportunities to improve fish habitat with new culvert installation and removal of the current hung/buried/crushed culvert currently acting as a barrier to fish passage. There will be up to 12 net zero scenarios involving new culvert installation where either no culvert is present currently (new construction), or the culvert that is present is functioning well. There are 9 watercourses that have been identified within the haul road PA and overlap with the existing road layout that will not be affected by the proposed alignment for the upgraded haul road.

6.6.7 Mitigation and Monitoring

Table 6.6-28 Direct and In-Direct Fish and Fish Habitat Impact Mitigation

Mitigation	Details	Direct Impacts	In-Direct Impacts
PRE-CONSTRUCTION			
Fish Awareness	- Complete pre-construction site meetings with relevant construction staff to educate staff to the locations of wetlands and watercourses and confirmed fish habitat and policies related to working around fish bearing surface water systems; - Identify and communicate schedule of construction activities as it relates to alteration of fish habitat - Provide copies of relevant maps and digital format locations of fish habitat as well as approvals, terms and conditions as it pertains to fish habitat to the contractor, all terms and conditions; - Ensure wetland boundary and watercourse location flagging tape is in place prior to construction activities taking place - Ensure all development related activity (i.e. construction areas, access roads etc.) are located within areas where biophysical field evaluations have been completed and approvals/written authorizations are in place as required, including work within 30m of a wetland or watercourse - Machinery and personnel will be instructed not to enter wetlands and watercourses outside of approved alteration areas - All staff will be made aware of Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters (Wright and Hopky, 1998) and associated setbacks will be confirmed during blasting activities during mine development	Y	Y – to prevent unnecessary impact to unaltered fish habitat
Sediment and Erosion Control	Management of silt laden water through use of silt fencing, on-site drainage control, and settling ponds	Y	Y – to prevent silt entering unaltered fish habitat
Ensure all sediment and erosion control methods are in place. Methods specifically relevant to working in proximity to wetlands and watercourses	Maintain existing vegetation cover whenever possible and minimize overall areas of disturbance. Also, ensure contractors minimize travel across areas of exposed soils. Maintaining existing vegetation cover is the best and most cost-effective erosion control practice;	Y	Y – to prevent erosion in unaltered fish habitat
	Manage construction and roadway runoff through natural vegetation.	Y	Y – to prevent run-off into unaltered fish habitat

Table 6.6-28 Direct and In-Direct Fish and Fish Habitat Impact Mitigation

Mitigation	Details	Direct Impacts	In-Direct Impacts
	Use of clean, non-ore-bearing, non-watercourse derived and non-toxic materials for erosion control methods	Y	Y – to mitigate down-gradient impacts
	Implement all erosion and sediment control practices prior to any soil disturbing activities, when applicable	Y	Y – to mitigate down-gradient impacts
	Drainage structures will be incorporated, where necessary, to dissipate hydraulic energy and maintain flow velocities sufficiently low to prevent erosion of native soil material; and	Y	Y – to mitigate down-gradient impacts
	Avoid frequent or unnecessary travel over erosion prone areas through communication with personnel and project planning.	Y	Y – to mitigate down-gradient impacts
	Erosion and sediment control planning will be completed to ensure site run-off is not directed towards fish habitat	Y	N
	Construction methods will consider techniques to reduce the potential to drain or flood fish habitat via indirectly altered hydrology due to mine development, site dewatering, or road construction	Y – partially altered fish habitat	Y – to mitigate down-gradient impacts
Accidents and Malfunctions	In order to protect fish habitat from accidental spills, ensure that the spill control and contingency planning is in effect, and its procedures fully communicated to staff	Y	Y – to mitigate down-gradient impacts
Monitoring (see additional information in Section 6.6.7)	Complete baseline monitoring measurements and observations prior to surface water alteration activities taking place so that comparisons with post alteration conditions can be ascertained.	Y – partially altered fish habitat	Y – In down gradient wetlands and watercourses subject to potential in-direct alteration
	Communicate with contractor Project staff the location of monitoring stations within remaining wetland and/or watercourse habitat supporting fish that is not approved for alteration	Y – partially altered fish habitat	N
Vegetation Management	Limit clearing within wetland and watercourse fish habitat outside of approved alteration areas	N	Y
	Vegetation management in or near wetlands and watercourses supporting fish will be conducted by cutting (e.g., no use of herbicides)	Y	Y

Table 6.6-28 Direct and In-Direct Fish and Fish Habitat Impact Mitigation

Mitigation	Details	Direct Impacts	In-Direct Impacts
	The slope between the edge of the mine infrastructure, roads or stockpile locations, or ditch and adjacent fish habitat will be re- vegetated to stabilize the slope, and limit erosion and sedimentation into each surface water system	Y – partially altered fish habitat	Y – to mitigate potential impact to unaltered fish habitat
Water Management	Maintenance of pre-construction hydrological flows into and out of down-stream surface water habitats and partially altered wetlands or watercourses, to the extent possible (post alteration monitoring maybe required as a result of provincial permitting process)	Y – partially altered fish habitat	Y – to mitigate down-gradient impacts
Fish Habitat Avoidance and Permitting	Fish habitat will be avoided wherever possible during detailed Project planning and design	Y	N
	Where fish habitat can't be avoided, minimization of total Project footprint within the surface water system will be considered during planning	Y	N
	Surface water alteration applications (wetlands and watercourses) will be submitted during Project planning and design to request an authorization to alter fish habitat. Loss of fish habitat will be addressed in these alteration applications and recommended timing windows will be adhered to for potential direct loss of fish and fish habitat;	Y	Y – only if in-direct downgradient fish habitats are expected to be altered
	Compensation for permanent loss of fish habitat will be completed through fish habitat restoration activities, subject to Fisheries and Oceans Canada (DFO), based on the Fisheries Act current at time of the Project construction.	Y	Y – only if in-direct downgradient fish habitats are expected to be altered
CONSTRUCTION/OPERATION PHASE			
Fish Habitat Awareness	Construction crews to adhere to wetland and watercourse alteration and general construction schedules	Y	N
	All work associated with wetland and watercourse alterations will have site-specific terms and conditions in the Approval which must be adhered to	Y	N
	Ensure all development related activity (i.e. construction areas, access roads etc.) are located within areas where biophysical field evaluations have been completed and approvals/written authorizations are in place as required, including work within 30m of a wetland or watercourse	Y	Y – to mitigate impacts to unaltered fish habitat

Table 6.6-28 Direct and In-Direct Fish and Fish Habitat Impact Mitigation

Mitigation	Details	Direct Impacts	In-Direct Impacts
Best Management Practices	For wetlands and watercourses where fish habitat is present where infilling has been approved, limit to materials permitted for use as documented within applicable approval documents and applicable timing windows for construction as directed by DFO	Y	N
	Maintenance of the sediment and erosion control mitigations in place prior to each new phase of construction	Y	Y – to mitigate impacts to unaltered fish habitat
	Limit driving and use of machinery within wetland and watercourse habitat where practical with use of swamp mats/corduroy bridges in wet areas to prevent rutting, temporary bridges, diverting water flow and sedimentation	Y	N – no use of machinery will be permitted in unaltered fish habitat
Blasting	Atlantic Gold is aware of the Wright and Hopky Guidelines For The Use Of Explosives In Or Near Canadian Fisheries Waters (DFO 1998) and will use these Guidelines to minimize impact to fish and fish habitat in the design of a blasting plan.	N	Y- potential to effect fish and fish habitat if setbacks and recommendations are not adhered to
Accidents and Malfunctions	Ensure proper fuel management by establishing and implementing spill management and contingency planning including use of staging areas for fueling a minimum of 30m from wetland and watercourse locations, and site signage to increase awareness.	Y	Y – to mitigate impacts to unaltered fish habitat
Vegetation Management	Maintain riparian wetland and watercourse buffers (where practical) to reduce adverse effects to wetlands, watercourses, and downstream receiving environments by clearly defining the limits of work	Y	Y – to mitigate down-gradient impacts
	Clearing of vegetation within wetlands and watercourse buffers should occur outside of the breeding bird window where possible, otherwise nesting surveys must be completed to ensure compliance with federal legislation	Y	N – no clearing will occur in unaltered fish habitat

Table 6.6-28 Direct and In-Direct Fish and Fish Habitat Impact Mitigation

Mitigation	Details	Direct Impacts	In-Direct Impacts
Monitoring	Complete regular monitoring during construction to ensure protective measures are being implemented at schedule and location as directed by regulators. It is anticipated that monitoring will occur daily during the construction phase and weekly during the operations phase.	Y	Y
DECOMMISSIONING			
Water Management	Structures and methods to manage surface water within the PA (i.e. culverts, diversion channels, settling ponds) will either be removed, or will remain in position. Structures left in place post decommissioning will be evaluated for their effectiveness at maintaining hydrological conditions such that existing fish habitat is preserved. Should structures be removed, an evaluation of potential impact to existing fish habitat will be completed and necessary mitigation steps will be implemented.	Y	Y
Vegetation	Upon final abandonment, areas that have erosion potential may be straw crimped and or matted and seeded to return the area to pre-disturbance conditions in a timely fashion	Y	Y
Monitoring	Regular monitoring will be completed to ensure protective measures are being implemented at schedule and location as directed by regulator. It is anticipated this will occur weekly during the reclamation and decommissioning period, and monthly post-reclamation. Monitoring of fish habitat in wetlands and watercourses to evaluate their condition and integrity may be necessary post decommissioning phase. This will ensure impacts have not occurred as a result of decommissioning activities (i.e. water management structure removal).	Y	Y – to mitigate impacts to down-gradient fish habitat

A fish and fish habitat monitoring program will be developed in association with requirements of wetland and watercourse alteration permits issued for direct wetland and watercourse alterations associated with the Project. Monitoring of surface water will also be completed which will support monitoring for potential impacts to fish and fish habitat. This monitoring program is described in Section 6.3.7.

Although no effects to fish or fish habitat are anticipated at the Touquoy facility due to the processing of Beaver Dam ore, surface water quality will continue to be monitored over the life of the Touquoy facility, which will provide data to evaluate any potential impacts to fish and fish habitat. Surface water monitoring locations are provided on Figure 2.2-4.

6.6.8 Residual Effects and Significance

The predicted residual environmental effects of Project development and production on fish and fish habitat are assessed to be adverse, but not significant. The overall residual effect of the Project on fish and fish habitat is assessed as not significant after mitigation measures have been implemented.

Table 6.6-29 Residual Environmental Effects for Fish and Fish Habitat

Project VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Significance Criteria for Residual Environmental Effects						Residual Effect	Significance
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
Clearing and grubbing (reduced infiltration, introduction of invasives)	Sediment and erosion control, reclamation during decommissioning and best management practices. (See mitigation: Table 6.6-28)	A	L	PA	LT	R	R	LD	Habitat Loss	Not Significant
Heavy machinery operation (impacts to water quality from dust, sediments, accidents and contamination)	Sediment and erosion control, spill preparedness and best management practices (See mitigation: Table 6.6-28)	A	M	PA	S T	R	R	LD	Disturbance	Not Significant
Direct fish habitat alteration (infilling, draining, flooding, altering wetland function, altering groundwater recharge capacity)	Engage wetland and watercourse permitting processes Wetland and surface water monitoring See mitigation: Table 6.6-28	A	M	PA	P	O	IR	LD	Habitat Loss	Not Significant
In-direct fish habitat alteration (water quality, hydrological imbalance, sedimentation)	Wetland and surface water monitoring See mitigation: Table 6.6-28	A	L	PA	M	S	R	LD	Disturbance	Not Significant

Table 6.6-29 Residual Environmental Effects for Fish and Fish Habitat

Project VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Significance Criteria for Residual Environmental Effects						Residual Effect	Significance
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
Widening and new haul road construction (hydrological changes, wetland and wc alteration and vegetation removal)	Engage wetland and watercourse permitting process Wetland and surface water monitoring See mitigation: Table 6.6-28	A	L	PA	P	O	IR	LD	Habitat Loss	Not Significant
Blasting (once per week) and drilling of in-situ rock	Pre-blasting plan and evaluation of potential to indirectly impact wetland habitat.	A	L	PA	S T	R	R	LD	Disturbance	Not Significant
Legend (refer to Table 5.10-1 for definitions)										

6.6.9 Proposed Compliance and Effects Monitoring Program

As the Project moves forward, monitoring programs will proceed to gather pre-construction fish and fish habitat baseline data. Monitoring programs will continue during construction, operation, and post-production to verify baseline conditions and to determine the effects of the Project on fish and fish habitat in the PA. Table 6.6-28 summarizes the mitigation and monitoring activities that will be completed throughout the life of the Project. A fish and fish habitat monitoring program will be developed in association with requirements of wetland and watercourse alteration permits issued for direct wetland and watercourse alterations associated with the Project. Monitoring of surface water will also be completed which will support monitoring for potential impacts to fish and fish habitat. This monitoring program is described in Section 6.3.7.

The details of the monitoring programs will be determined in consultation with regulatory agencies and will be described in the application for an IA for the site operations following the EA process. High level detail is needed in this application and would be subject to review by NSE and other agencies, including DFO. An EPP will be developed as part of the Project implementation that will confirm the responsibility and system of accountability for the compliance and effects monitoring program. Fish and fish habitat monitoring programs will include the following, as well as additional monitoring as determined through discussions with regulatory agencies, and monitoring programs underway as part of the wetlands and surface water quality monitoring programs:

- Regular monitoring during all phases of the Project to ensure protective measures are being implemented;
- Baseline monitoring measurements and observations prior to surface water alteration activities;
- Regular monitoring of fish habitat in wetlands and watercourses to evaluate their condition and integrity post decommissioning phase. This will ensure impacts have not occurred as a result of decommissioning activities (i.e. water management structure removal).

The frequency and location of fish and fish habitat monitoring will be described in greater detail in the EEM and EPP following consultation with regulatory agencies. The detailed planning is also expected to include collaboration with local conservation organizations, including sharing of monitoring data with the Nova Scotia Salmon Association.

6.7 Habitat and Flora

6.7.1 Rationale for Valued Component Selection

Flora species and communities, and the fauna species which rely upon these communities, may be altered, either directly or indirectly, by proposed Project activities. Field programs were developed to identify priority species, in particular SAR, which are protected under federal and provincial SAR legislation.

6.7.2 Baseline Program Methodology

6.7.2.1 Priority Species List Methodology and Desktop Evaluation

A detailed desktop study to examine potential for presence of and effects on SAR within the vicinity of the PA was completed. This desktop evaluation for SAR and SOCI was completed in advance of field programs to advise the detailed methodologies outlined in Sections 6.7.2.2 to 6.7.2.4. SAR and SOCI are collectively referred to as priority species.

Through consultation with NSE and Environment and Climate Change Canada, the Project Team has developed the following definitions for SAR and SOCI:

- A SAR is any species which is designated under the federal Species at Risk Act (Government of Canada, 2015) and any species designated under the provincial Nova Scotia Endangered Species Act (Province of Nova Scotia, 2015).
- A SOCI is one which is listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC, 2015) to be considered for federal protection under SARA, but does not yet have designation under SARA. In addition, a SOCI includes those listed as S1-S3 (provincial rarity rankings) by the Atlantic Canadian Conservation Centre (ACCDC, 2015).

A priority species list was compiled to identify potential SAR and SOCI which may be using the PA and surrounding lands for each taxonomic group. This priority species list was compiled in accordance with the requirements outlined in the NSE Guide to Addressing Wildlife Species and Habitat in an EA Registration Document (NSE, 2009b). Additional guidance was provided by NSDNR SAR biologist, Mark Elderkin. As per conversations with Mr. Elderkin during the early spring of 2015, it was requested that all priority species lists be built using status ranks (S-Ranks, S1, S2, S3) rather than general status ranks (GS-Ranks Red and Yellow). Table 6.7-1 provides the definitions of provincial status ranks (S-Ranks) (ACCDC 2017).

Table 6.7-1 Provincial Status Ranks Definitions

S-rank	Definition
SX	**Presumed Extirpated** - Species or community is believed to be extirpated from the province. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.
S1	**Critically Imperiled** - Critically imperiled in the province because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state/province.

Table 6.7-1 Provincial Status Ranks Definitions

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

Table 6.7-1 Provincial Status Ranks Definitions

S-rank	Definition
M	Migrant - Migrant species occurring regularly on migration at particular staging areas or concentration spots where the species might warrant conservation attention. Conservation status refers to the aggregating transient population of the species in the province.

As outlined in the EA guidance documented cited above, the compilation of a priority species list is habitat driven, rather than observation driven (based on information provided in reports from ACCDC or the Maritime Breeding Brid Atlas (MBBA), for example). This is based on the recognition that observation based datasets are not comprehensive lists of species identified in any given area. As such, the information provided observation driven sources are supplementary to the priority species list, rather than forming the basis of the priority species list.

The Project Team compiled a list of all SAR and SOCI as defined above with habitat preferences and geographic distribution (if known) included. To complete the Project-specific priority species list, the province-wide list was narrowed based on:

- Broad geographic area (for this Project, the broad geographic area considered is central mainland Nova Scotia);
- Habitat preferences; and,
- Presence of preferred habitat within the PA based on habitat survey results.

The final priority list of species used for field assessments is attached in **Appendix I.**

Once the priority species list was completed, the Project Team reviewed a series of additional data sources. Sightings of priority species recorded within 5 km and 100 km by ACCDC are reviewed (reports included in **Appendix J**). One report was prepared for the Beaver Dam mine footprint PA on September 8, 2014, and an additional report was prepared for the Haul Road PA on June 3, 2016. Those species which have been documented within 5km of the PA are underlined in Tables 6.7-2 and 6.7-3 below. If there were no species observed within 5km of the PA, by either ACCDC report, this was also stated.

When the ACCDC prepares a rare species report, they provide the user with georeferenced shapefile points of rare species records within 5 km of the center of the study area. However, NSDNR has classified several species as 'location sensitive', meaning that ACCDC is not permitted to provide specific location data for these species in their reports. Concern about exploitation of location-sensitive species precludes inclusion of coordinates in the rare species reports. Location sensitive species in Nova Scotia include black ash (*Fraxinus nigra*), Blandings turtle (*Emydoidea blandingii*), wood turtle (*Glyptemys insculpta*), peregrine falcon anatum/tundrius populations (*Falco peregrinus, pop.1*), and any bat hibernaculum. If any of these species are present within 5 km of the center of the study area, the ACCDC report will simply identify that they are present, but will not provide specific location data. No location sensitive species were documented within 5 km of the PA in either ACCDC report (Haul Road and mine footprint).

The Nova Scotia Museum of Natural History provided a list of flora and fauna SAR and SOCI documented by their staff within the vicinity of the PA, and the NSDNR Significant Species and Habitats Database was reviewed as well. The NS Museum report is provided in **Appendix J** and species identified in that report are highlighted in Tables 6.7-2 to 6.7-3. Significant Species and Habitats database results are shown on Figure 6.13-1. Two additional datasets were reviewed for priority invertebrates. These include the Maritime Butterfly Atlas and Odonata Central. These datasets provide records of butterfly and odonate observations, respectively.

The compilation of the priority species list and the review of all other available desktop resources for priority species observations is done primarily to advise field methodology, and they inform field staff to the species they are likely to encounter during field surveys. The desktop review for priority species provided the study team with information that directly guided the methods and the timing of all field programs. All field staff reviewed the desktop evaluation for priority species prior to commencing field work. This allowed field staff to review field identification guides and ensured that they were familiar with priority species identification and their status ranks.

6.7.2.2 Habitat Survey

Habitat assessments were completed in October 2014 and May 2015 within the mine footprint PA, and in May 2016 within the Haul Road PA. Using available forestry and wetland databases, habitat survey routes were created with the goal of assessing all of the major habitat types and landscape features throughout the PA.

The habitat survey methods and results are presented with the acknowledgment of three biases built into the survey methods.

- One bias is towards upland habitat. This bias was purposefully built into the survey methods with the understanding that all wetlands within the PA will be delineated and described in detail and their function as habitats within the landscape of the PA would be captured in the wetland program (Section 6.5).
- The second bias is towards forested landscape as opposed to non-forested landscapes. In this context, clear cut lands, or those which have experienced timber harvesting of any sort, are still considered forested because the removal of timber is only a temporary disturbance. Non-forested portions of the landscape, such as roads or extensive gravel areas, often associated with historic mine workings, were not assessed during the habitat survey simply because they lack forest cover to be described and their capability for supporting forest cover in the foreseeable future is low based on the level of disturbance.
- The third bias in this survey is that habitat surveys were completed at discrete points and no effort was made to delineate the extent of that habitat type around those points. As such, the ability to extrapolate habitat survey results across the entire PA is limited. These habitat survey points are meant to describe habitat in ‘snapshots’ of specific locations. The results of the habitat survey are meant to describe the diversity of habitat types present throughout the PA

and the relative abundance thereof, rather than absolute percent cover of each habitat type throughout the PA.

Two surveyors walked the habitat survey routes. Habitat survey points (HSPs) were established along the survey route based on anticipated and observed habitat types. The distance between habitat survey points was dependent upon the complexity of major habitat types across the landscape, approximately 250 m for the mine footprint and approximately 1 km along the Haul Road.

The Forest Ecosystem Classification (FEC) for Nova Scotia guide book was used to describe habitat characteristics within the habitat survey points. The following information was collected at each habitat survey point:

- Vegetation type was determined using Part 1 of the FEC guide (Neily et al., 2011). Each stand was classified by overall forest group code and vegetation type using the keys provided in the guide book. Forest groups are general groupings of vegetation types. Within each forest group (open woodland or tolerant hardwood, for example), there are several specific vegetation types. Vegetation types are recurring and identifiable plant communities which reflect differences in site conditions, natural disturbance regimes, and successional stage. For example, TH4 is a tolerant hardwood forest group dominated by sugar maple and white ash vegetation type, while TH6 is a tolerant hardwood forest group dominated by red oak and yellow birch vegetation type.
- Ecosite was determined using Part 3 of the FEC guide (Keys et al., 2011). This guide provides keys to identify ecosites using an edatopic grid, which is a two-dimensional diagram used to plot ecosystems and ecosites based on their relative moisture and nutrient regimes. Ecosites are units which represent ecosystems that have developed under a particular nutrient and moisture regime. A finite range of vegetation types will naturally grow in any given ecosite.
- An approximation of forest stand age was determined using broad classifications for stand age (regenerating, immature, mature, over mature). This approximation is based on a combination of factors, such as total basal area, level of canopy coverage, senescence of older trees and presence of cavity trees, and species composition of the canopy, shrub and understory vegetation.
- Natural or anthropogenic disturbance is recorded in each site. The level and type of disturbance is identified and the timing of the disturbance is noted as well if it is apparent. Examples of natural disturbances include timber harvesting or road development. Natural disturbance regimes include fire, pests, wind throw, and natural senescence.
- Representative photos were taken of each site.

Habitat survey results were purposefully biased towards upland habitats, based on the fact that the wetland program would collect detailed information about each individual wetland within the PA. The habitat surveys were completed early in the field evaluation (October 2014 in the mine footprint PA and May 2015 in the Haul Road PA). These surveys provide valuable insight into the overall habitat composition of the PA, while helping to inform methodologies of other field programs.

6.7.2.3 Vascular Plant Surveys

As described in the Guide to Addressing Wildlife Species and Habitat in an EA Registration Document (NSE, 2009b) and the Beaver Dam Mine Project Draft EIS Guidelines (CEAA, 2015), a complete vascular plant inventory is not typically required for an environmental assessment. In accordance with the documents referenced above, the vegetation survey focused on the identification of vegetative communities, with particular attention to identifying priority species. Priority species methodologies, including desktop review, are described in detail in Section 6.7.2.1.

Habitat types were identified on a broad scale within the PA and then meander transects through each habitat type were conducted in order to ensure that a variety of habitat types were surveyed for vegetation. One search was completed on September 8th, 12th, and October 9th, 2014 to assess the mine footprint PA for late season phrenology. The following spring, a search was completed to evaluate the mine footprint PA for spring ephemerals on June 22-23, 2015. Early phrenology surveys were completed within the Haul Road PA on June 22-23 2016, followed by late season surveys, which were completed on September 11-12, 2016.

For these surveys, a list of all rare species records found within 100 km of the PA was assembled prior to the survey being undertaken (from ACCDC and NS Museum data results) to provide additional information and support the priority species list regarding the potential presence of priority species within the PA. Two ACCDC reports were requested to cover observations within the mine footprint and along the Haul Road. The ACCDC and NS Museum data reports are provided in **Appendix J**. The specific timing of field surveys was determined based on the identification of priority species that were documented within 20 km of the Project Area by the ACCDC.

6.7.2.4 Lichen Surveys

Specific methods for lichen surveys were determined based on identification of SAR and SOCI lichens. The Project Team did not complete a comprehensive list of all lichen species within the PA. The lichenologist did record several opportunistic observations of lichen species during the focused surveys for lichen SAR and SOCI. Detailed methods for lichen SAR and SOCI field surveys and desktop evaluation are presented in Section 6.7.2 and all lichen results are described in Section 6.7.3.3.

6.7.3 Baseline Conditions

6.7.3.1 Habitat

The Beaver Dam Mine Project is located in the Eastern Ecoregion of the Acadian Ecozone. Ecoregions are subdivisions of the larger ecozones and express macroclimate as a distinctive ecological response to climate through soils and vegetation (Neily et al., 2005).

Ecoregions are further subdivided into ecodistricts, which reflect macroelements of the physical and biological attributes of ecosystems which will ultimately influence biodiversity. The three primary Project locations are spread across the further subdivided Eastern Interior and Eastern Drumlin Ecodistricts. The Eastern Interior Ecodistrict is generally characterized by highly visibly bedrock where glacial till is very thin, exposing the ridge topography. Where till is thicker, ridged topography is masked and thick softwood forests occur. There are a few drumlins and hills scattered throughout the ecodistrict and fine textured soils are derived from slates. The Eastern Drumlin ecodistrict are underlain by Meguma Group greywacke and slate, blanketed by fine-textured till derived from these underlying and adjacent rocks. Drumlins are derived from carboniferous rocks from the north, as well as material from the Cobequid Hills and Pictou-Antigonish Highlands.

Ecosites are units which represent ecosystems that have developed under a variety of conditions and influences, but which have similar moisture and nutrient regimes. An ecosite is associated with a finite range of soil and site conditions and a finite range of vegetation types that grow naturally under those conditions. Ecosites represent general productivity units and provide an ecological setting through which vegetation and soil types can be grouped and compared. In this application, the value in ecosite classification lies in wildlife habitat analysis and biodiversity considerations. For example, ecosite classification can be used to help determine the likelihood of finding particular rare plants that prefer specific moisture or nutrient regimes.

Within the mine footprint PA, habitat survey points confirmed six different ecosites. Ecosites identified within the mine footprint PA were within the moist to fresh moisture regime, with poor to medium nutrient regimes. These ecosites generally support vegetation types from the spruce-pine and spruce-hemlock forest groups. Generally, spruce-pine forest groups are associated with a natural disturbance regime of fire, which leads to stands dominated by spruce, pine, and understorey vegetation tolerant of acidic, nutrient poor conditions. Spruce-hemlock forest groups are characterized by red spruce (*Picea rubens*), white pine (*Pinus strobus*), and eastern hemlock (*Tsuga canadensis*). These species have high shade tolerance and are long lived species, which can support old growth conditions. Spruce-hemlock forest groups generally do not support many species of rare plants, but provide good quality habitat for a diversity of mammals and birds.

Of the 17 established habitat survey points within the mine footprint PA, the most abundant ecosite was AC10, accounting for 53% of all habitat survey points (see Figure 6.7-1). The next most abundant ecosite within the mine footprint is AC11, followed by AC6.

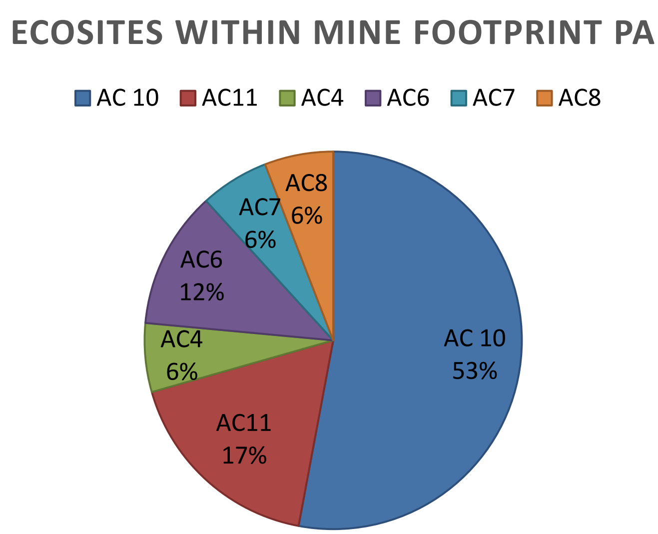


Figure 6.7-1. Relative Abundance of Ecosites within the Mine Footprint

Within the Haul Road PA, habitat survey points fell within nine different ecosites. Ecosites identified within the Haul Road PA were within the very dry to wet moisture regime, with very poor to rich nutrient regimes. These ecosites generally support a broader variety of vegetation types from the spruce-pine, intolerant and tolerant hardwood, mixed wood, open woodland, spruce-hemlock and intolerant hardwood forest groups.

Of the 20 established habitat survey points within the Haul Road PA, the most abundant ecosite was AC6, accounting for 30%. The next most abundant ecosite within the Haul Road PA is AC10 at 15%, followed by AC1, AC5, AC7, and AC10 at 10% each (see Figure 6.7-2).

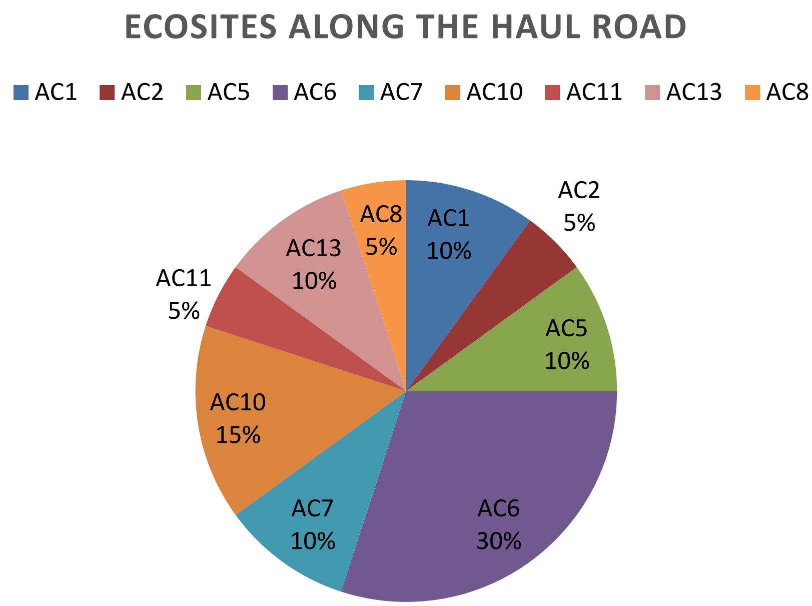


Figure 6.7-2. Relative Presence of Ecosites within the Haul Road

Figure 6.7-3 shows the combined ecosites observed along the entire PA. Details of each habitat survey point are outlined in Table 6.7-2.

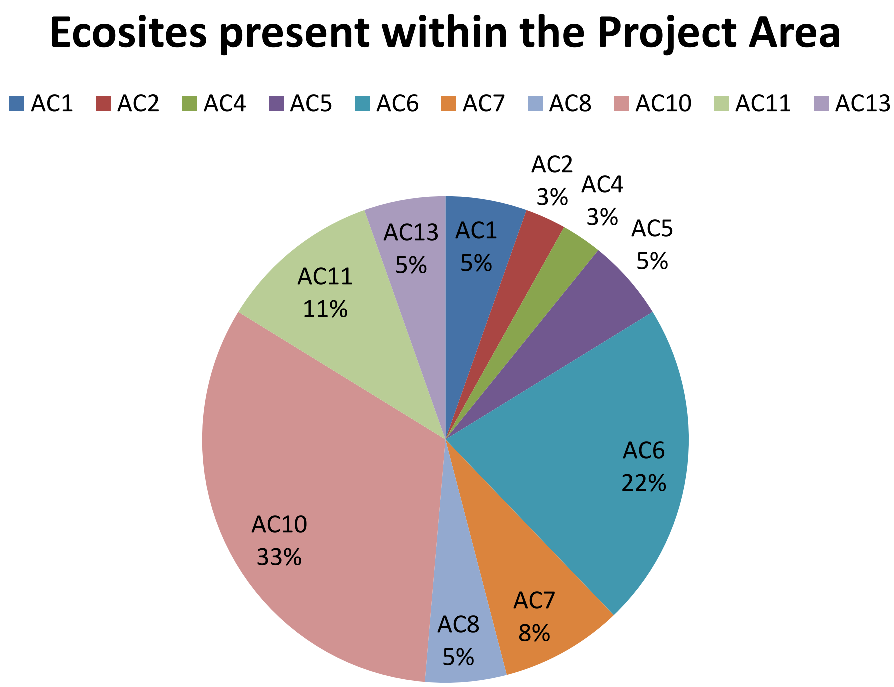


Figure 6.7-3. Ecosites present within the Project Area

Table 6.7-2 Habitat Survey results within the PA.

Habitat Survey Point	Ecosite	VT*	Stand age	Level and type of disturbance	Comments
HP001	AC10	SH4	Regenerating	Moderate - harvested	Overstory dominated by red spruce and balsam fir with white pine, yellow birch, and red maple. Understory dominated by sapling red spruce and balsam fir with velvet-leaved blueberry, bracken fern, bunchberry, and goldthread groundcover.
HP002	AC7	SP6	Immature	Low	Overstory dominated by balsam fir and black spruce with tamarack, red maple, and white birch. Understory dominated by regenerating balsam fir and black spruce with raisin, bracken fern, sheep laurel, goldthread, and creeping snowberry.
HP003	AC6	SP4	Regenerating	Moderate - harvested	Some remnant mature white pine in overstory with black spruce, tamarack, black spruce, balsam fir, and red maple. Understory dominated by regenerating balsam fir and bracken fern with black spruce, red maple, wild raisin, mountain holly, sheep laurel, bunchberry, and velvet-leaved blueberry.

Table 6.7-2 Habitat Survey results within the PA.

Habitat Survey Point	Ecosite	VT*	Stand age	Level and type of disturbance	Comments
HP004	AC11	SH3	Immature	Low	Softwood stand. Overstory dominated by red spruce and balsam fir with red maple, yellow birch, and white pine. Understory dominated by regenerating balsam fir and hay-scented fern with red spruce, bunchberry, evergreen wood fern, and lady fern.
HP005	AC11	SH5	Regenerating	Harvested	Disturbed stand. Overstory dominated by red spruce and red maple with yellow birch and white birch. Understory dominated regenerating balsam fir with red maple and wild raisin.
HP006	AC8	WC7	Immature	Low	Treed coniferous swamp. Overstory dominated by tamarack with red maple, balsam fir, black spruce, and white birch. Understory dominated by spinulose wood fern, balsam fir, speckled alder, bunchberry, and creeping snowberry.
HP007	AC10	MW1	Regenerating	Harvested	Disturbed stand. Overstory dominated by red spruce with yellow birch, red maple, and white birch. Understory dominated by regenerating balsam fir and strawberry with red spruce, red maple, yellow birch, sheep laurel, Labrador tea, creeping snowberry, and white meadowsweet.
HP008	AC10	TH7	regenerating	Harvested	Disturbed stand. Overstory dominated by yellow birch with balsam fir and white birch. Understory dominated by regenerating yellow birch and balsam fir. Mature trees are entirely absent, as is herb layer due to leaf litter/canopy cover.
HP009	AC10	SH8	Immature	Low	Softwood stand. Overstory dominated by balsam fir with red maple and yellow birch. Understory dominated by balsam fir, red maple, and bunchberry.
HP010	AC11	SH4	Immature	Low	Softwood stand. Overstory dominated by white pine with red spruce, balsam fir, and red maple. Understory dominated by bunchberry with sheep laurel and balsam fir.
HP011	AC10	MW2	Regenerating	Harvested	Disturbed stand. Overstory dominated by red spruce with white pine, balsam fir, red maple, and white birch. Understory dominated by red spruce saplings and sheep laurel with red maple saplings, wild raisin, bunchberry, mayflower, and bracken fern.

Table 6.7-2 Habitat Survey results within the PA.

Habitat Survey Point	Ecosite	VT*	Stand age	Level and type of disturbance	Comments
HP012	AC10	MW2	Regenerating	Harvested	Disturbed stand. Overstory dominated by red spruce with red maple, balsam fir, white birch, white pine, and yellow birch. Understory dominated by regenerating balsam fir and bunchberry with pin cherry, tamarack, sheep laurel, bracken fern, mayflower, and velvet-leaved blueberry.
HP013	AC10	MW2	Regenerating	Harvested	Disturbed stand. Overstory dominated by red maple with white birch, red spruce, and yellow birch. Understory dominated by regenerating balsam fir with twinflower, bunchberry, low-bush blueberry, red raspberry, and New York fern.
HP014	AC10	MW2	Regenerating	Harvested	Disturbed stand. Overstory dominated by balsam fir with red spruce, red maple, yellow birch, and white birch. Understory dominated by regenerating balsam fir, red maple, and bunchberry with red spruce, yellow birch, bracken fern, and twinflower.
HP015	AC10	SH5	Mature	Low	Balsam fir and black spruce. Very little understory vegetation.
HP016	AC4	WC2	Immature	Low	Treed coniferous swamp. Overstory dominated by black spruce with tamarack, red maple, and balsam fir. Understory dominated by wild raisin and Labrador tea with red maple, black spruce, tamarack, sheep laurel, bunchberry, twinflower, cinnamon fern, and steeplebush.
HP017	AC6	SP4a	Regenerating	Harvested	Disturbed stand with remnant mature white pine in overstory. Overstory dominated by black spruce, balsam fir, white pine, and red maple. Understory dominated by regenerating balsam fir and sheep laurel with wild raisin, bunchberry, bracken fern, velvet-leaved blueberry, mountain holly, and teaberry.
HP018	AC6	SP4a	Regenerating	Harvested	Disturbed- cut. Overstory dominated by balsam fir, black spruce, red maple, white pine. Understory dominated by sheep laurel, wild raisin, bracken fern, and teaberry.
HP019	AC1	SP3a	Immature	Low	Overstory dominated white birch and balsam fir, red and black spruce, white pine. Understory dominated mayflower, bracken fern, and sheep laurel.
HP020	AC6	IH6	Regenerating	Harvested	Disturbed. Overstory dominated by red maple and white birch.
HP021	AC10	MW4	Immature to mature	Low	Overstory dominated white birch, yellow birch.

Table 6.7-2 Habitat Survey results within the PA.

Habitat Survey Point	Ecosite	VT*	Stand age	Level and type of disturbance	Comments
HP022	AC7	SH5	Immature to mature	Harvested	Disturbed. Overstory dominated by red spruce.
HP023	AC13	IH7	Immature to mature	Low	Overstory is abundant yellow birch and red maple.
HP024	AC13	IH7	Mature	Low	Overstory dominated red maple.
HP025	AC8	WC6	Mature	Low	Overstory dominated by red spruce. Understory dominated by cinnamon fern, bracken fern, sheep laurel, and Labrador tea.
HP026	AC5	SP4	Mature	Low	Overstory dominated by white pine and red spruce. Understory dominated by red maple and balsam fir, occasionally.
HP027	AC2	OW2	Mature	Low	Overstory has abundant cover of red spruce. Shrub layer dominated by white birch. Understory dominated by sheep laurel, teaberry, and bracken fern.
HP028	AC7	SP4	Mature	Low	Overstory dominated by white pine.
HP029	AC10	TH7	Mature	Low	Overstory dominated by yellow birch. Understory dominated by evergreen wood fern.
HP030	AC6	SH5	Mature	Low	Overstory dominated by balsam fir.
HP031	AC10	MW1	Immature to mature	Low	Overstory has abundant cover of balsam fir, white birch, and yellow birch.
HP032	AC6	SH5	Immature to mature	Low	Overstory has abundant red spruce. Understory dominated by cinnamon fern.
HP033	AC1	OW2	Mature	Low	Overstory dominated by black spruce. Understory dominated by teaberry and bracken fern.
HP034	AC5	SH5	Mature to over mature	Low	Overstory dominated by black spruce. Understory dominated by sheep laurel and bracken fern.
HP035	AC6	SH5	Mature to over mature	Low	Overstory dominated by red spruce and red maple. Understory dominated by sheep laurel.
HP036	AC6	SP5	Mature	Low	Overstory dominated by black spruce. Understory dominated by bracken fern.
HP037	AC11	SH4	Mature	Low	Overstory dominated by red spruce and black spruce. Understory dominated by sheep laurel.

*VT: Vegetation Type.
HP01-HP17 are within the mine footprint PA, HP18-37 are within the haul road PA

The ecosites identified throughout the PA are described herein, grouped by predominant nutrient regime.

6.7.3.1.1 Very Poor Nutrient Regime

Ecosites with very poor nutrient regimes encountered within the PA include AC1, AC2, and AC4. These ecosites represent very dry, fresh, and moist/wet moisture regimes, respectively. Ecosite AC1 was observed twice within the Haul Road PA. At the survey points, the PA supported open woodland and spruce-pine vegetation types, typical of dry moisture regimes within the very poor nutrient regime. This ecosite occurs mainly on upper slopes or crests of exposed bedrock. Ecosite AC2, also observed within the Haul Road PA, supported an open woodland forest type as well. One of the habitat survey points assessed was classified as ecosite AC4, which occurs mainly on poorly to very poorly drained level areas and depressions with coarse textured glacial till and/or organic deposits. This ecosite has wet, very nutrient poor to very poor soils, which generally support poorly stocked stands of black spruce with tamarack (sometimes stunted).

6.7.3.1.2 Poor Nutrient Regime

Forty percent of habitat survey points were classified under a very poor nutrient regime. Ecosites AC5, AC6, AC7, and AC8 represent dry, fresh, moist, and wet moisture regimes, respectively.

Ecosite AC5 occurs on well- to rapidly-drained sites and generally supports a canopy of white pine, red spruce, black spruce, or red maple. Within the PA, this ecosite supported spruce-pine and spruce-hemlock vegetation types. Ecosites AC6 and AC7 occur primarily on well drained to imperfectly-drained slopes with coarse textured glacial till deposits and fresh to moist, nutrient poor soils. These conditions generally support closed canopy stands of white pine and black spruce. When balsam fir is present, it is generally intermediate in the canopy and of low vigor. Early successional stands are dominated by large-toothed aspen (*Populus grandidentata*), red oak (*Quercus rubra*), and red maple. Within the PA, habitat survey points within these ecosites were identified to be within the spruce-pine, intolerant hardwood, and spruce-hemlock forest groups.

Ecosite 8 typically occurs in depressions or areas with poorly or very poorly drained soils, generally supporting wetland habitat. Typical canopy coverage within this ecosites can range from spruce, balsam fir, and larch, and occasionally red maple and white ash. Within the PA, this ecosite supported a wet coniferous forest group.

6.7.3.1.3 Medium Nutrient Regime

Within the PA specifically, and within Nova Scotia more generally, the majority of Acadian climax softwood and mixed wood forests are found on AC10 and AC11 sites. Occurring mainly on well-drained slopes with medium textured glacial till deposits, AC10 has fresh, nutrient-medium soils which generally support late successional forests dominated by red spruce, eastern hemlock, and yellow birch. Earlier successional forests contain balsam fir, white birch, red maple, and trembling aspen (*Populus tremuloides*). Within the PA, a variety of vegetation types and forest groups were found within AC10 ecosites, including mixed wood, spruce-hemlock, and tolerant hardwood forest groups.

Occurring mainly on imperfectly drained lower slopes and level areas with medium textured glacial till deposits, AC11 ecosites have moist, nutrient-medium soils which generally support mixed wood climax communities dominated by red spruce, hemlock and yellow birch. Earlier successional forests are similar in nature to those found in AC10. Within the PA, four of the habitat survey points within ecosite AC11 were identified within the spruce-hemlock forest group, while a single site was identified within the spruce-pine forest group.

6.7.3.1.4 Rich Nutrient Regime

Ecosite AC13 was observed in two locations within the Haul Road PA. This ecosite occurs on well drained slopes with a fresh to moist water regime. This ecosite typically supports late successional forests dominated by sugar maple, American beech, yellow birch, white ash, and red maple. Early successional stands may be dominated by aspen or white birch. In each location observed within the PA, this ecosite supported an intolerant hardwood vegetation type, dominated by mature red maple and yellow birch.

6.7.3.1.5 Habitat Survey Conclusions

Upland forests in the mine site PA have experienced relatively high levels of disturbance from timber harvesting. Fifty-eight percent of locations surveyed experienced some level of disturbance, typically timber harvesting, within the recent past. While mature, undisturbed habitats are present in the mine site PA, particularly in large wetland complexes, generally, the mine footprint has experienced significant levels of disturbance. As mentioned in the methodology section, portions of the mine footprint PA have experienced significant levels of disturbance from historic mining practices as well.

The level of disturbance identified within the haul road PA is significantly lower, with only 15% of points surveyed having experienced timber harvesting. However, 80% of the survey was completed within approximately 50 m of an existing road. This means that many natural forest stands are present, but the overall landscape is still somewhat disturbed, based on habitat fragmentation by the presence of an existing road. The effect of habitat fragmentation and disturbance to terrestrial fauna is described in further detail in Section 6.8.6.

In areas affected by natural or anthropogenic disturbance (e.g., wind throw or tree harvesting, respectively), early successional stands were determined to be in the mixed wood forest group. The dominant disturbance regime in the PA is timber harvesting, which is present in patches throughout upland forests. Generally speaking, uplands within the PA contain immature or unevenly aged coniferous stands or mixed wood stands. Several pockets of mature coniferous forests are scattered throughout the PA, but over-mature stands were generally uncommon. Pure deciduous stands (including both tolerant and intolerant hardwood forests) are infrequent within the mine footprint PA, though they do occur occasionally within the Haul Road PA.

The ecosites and vegetation types observed are representative of the Eastern Ecoregion of the Acadian Ecozone as described in Section 6.2.3.1. The habitat survey results indicate a greater diversity of ecosites and vegetation types within the Haul Road PA compared with the mine footprint PA. This is to be expected given the broader geographic extent of the Haul Road and the relatively disturbed nature of the mine footprint. None of the ecosites or vegetation types across the PA are unique or rare in the local or regional context. Furthermore, none of the ecosites observed are known to have an elevated potential to support rare vegetation species (for instance, ecosites AC14, AC16 and AC17 are all documented as having higher potential to support rare and at risk vegetation species).

Overall, current and historic land use throughout the PA has resulted in a patchwork of mature, immature, regenerating, and disturbed stands. The PA contains a diversity of habitat types and landscape features, but has experienced a considerable amount of disturbance and habitat fragmentation as a result of historic mine operations and current and historic timber harvesting practices.

6.7.3.2 Vascular Plants

A total of 294 species of vascular plants were identified. The diversity of species is moderate to high, especially considering the low fertility of soils within the PA; however, this is attributed to the range of habitat types encountered, from natural aquatic systems, a variety of wetland types, and both intact and disturbed upland habitats. The vegetation species observed are largely native species, with relatively low diversity and abundance of roadside exotic or invasive species. The species and communities of vascular plants encountered were typical given the eco-regional context, nutrient regimes, moisture regimes, and disturbance regimes. Of the 294 species identified, five are considered priority species (S-Ranks of S3 and S3S4). These will be discussed further in Section 6.10.

Upland habitat throughout the PA is characterized by exposed granite boulders and coarse-textured, well-drained soil. The soil shows evidence of an impoverished condition, with low nutrient levels. This is evident in the forest groups and vegetation types that are found, as outlined in Section 6.7.3 (habitat survey results). Ericaceous shrub species such as sheep laurel (*Kalmia angustifolia*) and black huckleberry (*Gaylussacia baccata*) are frequent, along with other species which thrive in impoverished soil, such as mountain holly (*Nemopanthus mucronatus*), wild raisin (*Viburnum nudum*), and black spruce (*Picea mariana*). Where somewhat richer, finer soil till deposits are present, mixed wood to tolerant hardwood forests occur and include dominant species such as yellow birch (*Betula alleghaniensis*), red maple (*Acer rubrum*) and occasionally large-toothed aspen (*Populus grandidentata*).

Overall, understory vegetation layers are characteristic of low to medium soil fertility forest ecosystems described in Nova Scotia's Forest Ecosystem Classification system. Indicator species occurring in medium fertility sites include northern long beech fern (*Phegopteris connectilis*) and christmas fern (*Polystichum arctostichoides*), while species occurring in poorer conditions include trailing arbutus (*Epigaea repens*), bracken fern (*Pteridium aquilinum*), and pink lady's-slippers (*Cypripedium acaule*). Large portions of the PA, particularly within the mine footprint, have undergone large-scale anthropogenic disturbance in the form of clearcutting, which has resulted in a much younger forest landscape with less valued, more shade-intolerant and opportunistic tree species. Much of the diversity of vascular plants is attributed to wetland habitat. Wetlands have been described in detail in Section 6.5. The wetlands encountered generally supported vascular plant communities typical of nutrient poor peatlands and treed swamps, such as leatherleaf (*Chamaedaphne calyculata*), Atlantic sedge (*Carex atlantica*) and tussock sedge (*Carex stricta*) dominated low shrub bogs, and black spruce (*Picea mariana*), mountain holly (*Nemopanthus mucronatus*), and cinnamon fern (*Osmunda cinnamomea*) swamps. Open wetlands are primarily dominated by sphagnum moss with scattered and dwarfed black spruce, red maple (*Acer rubrum*), and speckled alder (*Alnus incana*). Several common species of Atlantic coastal plain flora were observed within wetlands throughout the PA. These include species such as branched bartonia

(*Bartonia paniculata*), Atlantic sedge, dwarf huckleberry (*Gaylussacia bigeloviana*), bog fern (*Thelypteris simulata*), and purple bladderwort (*Utricularia purpurea*). Vegetation communities identified throughout the PA generally exhibit low fertility and low potential for rare species. Rare species identified throughout the PA will be discussed in detail in Section 6.10. A complete plant list of all vascular plants identified within the PA is included in **Appendix K**.

6.7.3.3 Lichens

The lichen survey study area shown on Figure 6.8-1 was established based on increased potential for rare lichens in the general vicinity of the mine footprint and the level of proposed ground disturbance within the mine footprint. The goal of the expanded study area for lichens around the mine footprint PA was to determine, if rare lichens were identified within the mine footprint, whether these species were unique to that specific location or whether they were present within the broader geographical context.

A comprehensive list of lichen species was not completed, as the primary focus was in identifying rare or at-risk lichen species. However, common lichen species observed opportunistically during rare lichen surveys were recorded and are presented in the table below. Twenty species were recorded within the lichen study area (mine footprint, surrounding area, and Haul Road). Of these species, seven are listed as SAR or SOCI. More details on rare species results, including location details and habitat associations, are presented in Section 6.10. Table 6.7-3 below provides a list of species observed within the study area.

Table 6.7-3 Lichen species observed within the lichen study area

Common name	Scientific name	COSEWIC	SARA	NSESA	S-Rank	PA or LSA*
Boreal Felt Lichen	*Erioderma pedicellatum*	E	E	E	S1S2	LSA
Blue Felt Lichen	*Degelia plumbea*	SC	SC	V	S2	Both
Frosted Glass-whiskers Lichen	*Sclerophora peronella*	SC	SC	-	S1?	Both
Blistered Tarpaper Lichen	*Collema nigrescens*	-	-	-	S2S3	PA
Blistered Jellyskin Lichen	*Leptogium corticola*	-	-	-	S2S3	PA
Peppered Moon Lichen	*Sticta fuliginosa*	-	-	-	S3	PA
Coccocarpia Lichen	*Coccocarpia palmicola*	-	-	-	S4S5	Both
Jelly Lichen	*Collema subflaccidum*	-	-	-	S4S5	Both
Blue Jellyskin Lichen	*Leptogium cyanescens*	-	-	-	S4S5	Both

Common name	Scientific name	COSEWIC	SARA	NSESA	S-Rank	PA or LSA*
Pink-earth Lichen	*Diabaeis baemoyces*	-	-	-	S4S5	PA
Star-tipped Reindeer Lichen	*Cladonia stellaris*	-	-	-	S4S5	PA
Gray Reindeer lichen	*Cladonia rangiferina*	-	-	-	S4S5	PA
British Soldiers	*Cladonia cristatella*	-	-	-	S4S5	Both
Beard Lichen	*Usnea sp.*	-	-	-		Both
Yellow Specklebelly	*Pseudocyphellaria perpetua*	-	-	-	S4S5	Both
Lungwort Lichen	*Lobaria pulmonaria*	-	-	-	S4S5	Both
Textured Lungwort	*Lobaria scrobiculata*	-	-	-	S4S5	Both
Smooth Lungwort	*Lobaria quercizans*	-	-	-	S4S5	Both
Crumpled Rag Lichen	*Platismatia tuckermanii*	-	-	-	S4S5	PA

*PA: observed within the Project Area. LSA: Identified within the broader lichen study area only.

While the specific habitat requirements of each of priority lichen species varies slightly, they all require mature to over-mature forests. Stand age is one of the greatest determinants of lichen diversity (McMullin, Duinker, Cameron, Richardson, & Brodo, 2008). Within the mine footprint PA and broader LSA, small to moderate scale disturbance is abundant in the form of timber harvesting, particularly to the north and east of the PA; however, where mature, intact natural stands within the mine footprint PA support several rare species of lichen. According to lichen specialist, Chris Pepper, the habitat along the Haul Road PA generally lacked over-mature red maple and balsam fir required to support rare lichen species. This habitat is present within and surrounding the mine footprint PA, where forest stands supported a diversity of cyanolichen species. According to Mr. Pepper, the diversity and abundance of lichen species observed within the entire PA, including priority species is typical of similar habitats in this part of Halifax County.

6.7.4 Consideration of Consultation and Engagement Results

Key issues raised during public consultation and Mi’kmaq engagement relating to habitat and flora include potential effect on biodiversity and permanent loss of habitat associated with footprint of the Beaver Dam Mine site and haul road. Potential effects on traditional uses of land and resources by the Mi’kmaq were noted, including medicinal food and plants.

The results of the public consultation and Mi’kmaq engagement have been considered in the environmental effects assessment, including the Proponent’s commitments on mitigation and monitoring measures and proposed compliance and effects monitoring programs, as well as the Proponent’s broader commitment to ongoing public consultation and Mi’kmaq engagement. Specific to evaluating the effect on habitat and flora, these are found within the following environmental effects assessment.

6.7.5 Effects Assessment Methodology

6.7.5.1 Boundaries

Spatial Boundaries

The spatial boundaries used for the assessment of effects to flora are the mine footprint and the haul road PA. The LAA consists of any habitat contiguous and consistent with habitat available within the PA. These spatial boundaries will help to identify the direct or indirect impacts to flora species and critical habitats, and the effects of the Project on distribution and abundance of these species.

Temporal Boundaries

The temporal boundaries used for the assessment of effects to flora are the construction phase, operational phase, and decommissioning and reclamation phase.

Technical Boundaries

No technical boundaries were identified for the effects assessment of habitat and flora.

Administrative Boundaries

There are no administration boundaries (specific legislation) that guided the evaluation of flora and habitat for this EIS.

6.7.5.2 Thresholds for Determination of Significance

A significant adverse effect from the Project on flora is defined as an effect that is likely to cause a permanent alteration to any flora species distribution or abundance. An adverse effect that does not cause a permanent alteration in distribution or abundance of any floral species is considered to be not significant.

6.7.6 Project Activities and Habitat and Flora Interactions and Effects

Table 6.7-4 Potential Flora Interactions with Project Activities at Beaver Dam Mine Site

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Clearing, grubbing, and grading in preparation of construction • Till and waste rock from site preparation transport and storage • Existing settling pond dewatering in preparation of construction • Watercourse and wetland alteration in preparation of construction • Mine site road construction • Surface infrastructure installation and construction • Collection and settling pond construction • General management of wastes derived from preparation and construction activities

Table 6.7-4 Potential Flora Interactions with Project Activities at Beaver Dam Mine Site

Project Phase	Duration	Relevant Project Activity
		• Accidents and malfunctions to include fuel and other spills, forest fires, settling pond overflow, slope failure, an unplanned explosive event, and a mobile equipment accident
Operation and Maintenance	3-4 years	• Surface mine dewatering to facilitate access to and extraction of ore • Petroleum products management • Environmental monitoring of adjacent wetlands • General management of wastes derived from operation and maintenance activities • Accidents and malfunctions to include fuel and other spills, forest fires, settling pond overflow, slope failure, an unplanned explosive event, and a mobile equipment accident
Decommissioning and Reclamation	1-2 years	• Site reclamation activities • Environmental monitoring of adjacent wetlands • General management of wastes derived from decommissioning and reclamation activities • Accidents and malfunctions to include fuel and other spills, forest fires, and mobile equipment accidents

Table 6.7-5 Potential Flora Interactions with Project Activities along Haul Road

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Clearing, grubbing, and grading in preparation of construction • Watercourse and wetland alteration in preparation of construction • Haul road construction and upgrades • Environmental monitoring of adjacent wetlands • General management of wastes derived from preparation and construction activities • Accidents and malfunctions to include fuel and other spills, forest fires, and a haul truck accident
Operation and Maintenance	3-4 years	• Haul road maintenance and repairs including sanding for traction control and snow removal • Environmental monitoring of adjacent wetlands • Accidents and malfunctions to include fuel and other spills, forest fires, and a haul truck accident
Decommissioning and Reclamation		N/A[1]
1 Decommissioning and Reclamation of the Haul Road is not expected. The haul road will be returned to owner for forestry industry		

Table 6.7-6 Potential Flora Interactions with Project Activities at Touquoy Processing and Tailings Management Facility

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Accidents and malfunctions to include fuel and other spills, forest fires, and mobile equipment accidents
Operation and Maintenance	3-4 years	• Environmental monitoring • General management of waste derived from processing activities • Accidents and malfunctions to include fuel and other spills, forest fires, and a haul truck accident
Decommissioning and Reclamation	1-2 years	• Environmental monitoring • Accidents and malfunctions to include fuel and other spills, and forest fires

The Touquoy facility is currently under construction. Based on work completed as part of the 2007 Focus Report, lichens are not anticipated to be affected by the continued use of the Touquoy facility for the processing of Beaver Dam ore. Lichens are susceptible to air pollution, including deposition of contaminants in air emissions and particulate matter. It was concluded in the Focus Report that total suspended particulate from the processing facility at Touquoy will not have a significant adverse effect on any listed lichen species in the region.

There are no direct or indirect effects to flora or habitat anticipated to be caused by the processing of ore and the management of tailings from the Beaver Dam Mine Project. The use of the Touquoy facility for the processing of Beaver Dam ore will not involve construction of the mine site or any new disturbances, and as identified above, air emissions are not anticipated to have an adverse effect on flora; therefore, no effects are anticipated at the Touquoy facility related to the processing of Beaver Dam ore, with the exception of the continued potential for accidents and malfunctions and continued environmental monitoring.

Development of the mine footprint and upgrading and construction of new sections of the Haul Road will result in direct impacts to vascular and non-vascular individuals and to flora communities at the full or partial forest stand level. The effects of the Project on flora encompass vascular and non-vascular flora in aquatic, wetland, and upland habitats. As such, many of the effects described in Section 6.5 specific to wetland habitat will directly relate to effects on flora. The majority of direct mortality to flora will occur during site preparation and construction.

Project activities have the ability to indirectly affect flora in the construction, operational, and decommissioning phases of the Project. The vast majority of Project interactions with flora will occur during construction, specifically during clearing, grubbing, and grading. Indirect impacts could include altered hydrology as a result of activity (including dewatering) in close proximity to wetland habitat; erosion and sedimentation from Project activities; dust accumulation on vegetation smothering and stressing plants; accidental spills involving deposition of a deleterious substance, including fuel oil, lubricants, or engine oil, and impoundment of up-gradient wetlands if inadvertent dams are built as part of the mine development (roads can act as dams if not constructed properly to allow water flow through them).

Movement of equipment during site preparation, operation, and maintenance can result in deposition of dust on vegetation within close proximity of roads when conditions are dry. This affects flora through the deposition of dust on leaves, which temporarily reduces evapotranspiration and photosynthesis. Over time this may reduce overall growth rates. Similarly, winter maintenance of Haul Roads and site roads can affect plant growth adjacent to roads by placement of sand or stockpiling of snow. Road salt will not be used, thereby reducing potential impact to vegetation.

Additional indirect impacts to native plant communities include the potential for introduction of invasive species. Seeds and roots of invasive species can be transferred from construction equipment, transportation vehicles, or workers (footwear and clothing) into adjacent habitat during construction and operational activities. Introduction of invasive species can occur when equipment or people enter vascular plant communities, or indirectly via runoff or dust from the roads. Invasive species, such as purple loosestrife (*Lythrum salicaria*), can severely degrade habitat quality and outcompete many native species, particularly along roadsides. Construction of the Project within the mine footprint, upgrades to the Haul Road, and operations/trucking along the Haul Road will result in increased traffic levels. As a result, the likelihood of introduction of invasive species is elevated within the mine footprint and along the entire length of the Haul Road, including the section of the Mooseland Road to the Touquoy Mine, where although no road upgrades are necessary, truck traffic will increase. No purple loosestrife was noted during field surveys in the mine footprint or Haul Road PA. Routine inspections and cleaning of equipment that is brought from a different area can help identify and reduce potential spread of invasive species.

Table 6.7-7 Direct and Indirect Impacts on Habitat and Flora

Impact Type	Direct Impact	Project Phase1	Indirect Impact	Project Phase1
Vegetative and Habitat Integrity	Direct loss of individual vegetation (vascular and non-vascular) and the habitats which support them. In some cases (particularly in the mine footprint) whole forest stands (upland and wetland) will be removed.	C	Hydrologically connected upstream wetlands may also be at risk of indirect impacts as a result of downstream alteration activities (e.g., water outflow changes, land elevation changes, blasting, etc. causing dewatering). Inadvertent damming of up-gradient wetlands from construction related infrastructure (e.g., roads with lack of flow through infrastructure). Removal of tree cover in one area can increase risk of wind damage in immediately adjacent habitats.	C O D
	Extensive ground works, including activities such as blasting in and adjacent to wetlands has the potential to destabilize land surfaces and the root zone of vegetative areas, including wetland buffers.	C D	Introduction of invasive species can occur indirectly into wetlands when equipment or people move around the PA or via runoff or dust from the roads. Introduction of mine and Haul Road traffic during construction and operation can elevate this risk. Invasive species, such as purple loosestrife (Lythrum salicaria), can severely degrade wetland habitat and function. No purple loosestrife was noted during field surveys in the mine footprint or Haul Road PA.	C O D
	Introduction of invasive species. Seeds and roots of invasive species can be transferred from construction equipment, transportation vehicles, or workers into adjacent wetland habitat during construction and operational activities.	C O D	Dust accumulation on vegetation can smother and stress plants and provide minerals and nutrients into the wetland habitat.	C O D

6.7.7 Mitigation and Monitoring

In order to mitigate and reduce overall loss of function of habitat used by terrestrial flora, the following actions will be implemented where direct loss of habitat is expected to support mine and Haul Road development:

- Intact forest stands and wetlands will be avoided wherever possible during detailed Project planning and design in favor of previously disturbed areas (e.g., stands disturbed by timber harvesting, roads, or other development);
- Topsoil will be salvaged and stored for use in site restoration where possible. Upland and wetland soils should be stockpiled separately;
- Where natural, intact habitat cannot be avoided, minimization of total Project footprint will be considered during detailed planning;
- Erosion and sediment control planning will be completed to ensure site runoff is not directed towards unaltered habitat where possible to ensure existing drainage patterns are maintained;
- The effect of dust accumulation on adjacent undisturbed vegetation can be mitigated by monitoring dust conditions and when normal precipitation levels are not enough to suppress fugitive dust, water trucks can be used to suppress dust. This reduces potential impact on fauna and improves safety and visibility for other vehicular traffic as well;
- Winter road maintenance will include conventional snow clearing and deposition of sand for traction control where necessary. Road salt will not be used;
- Haul trucks will be equipped with spill kits and instructed on their use and spill prevention and appropriate site personnel will be trained in spill isolation, containment, and recovery;
- A wetland alteration application will be submitted during Project planning and design to request an authorization to alter wetland habitat. Loss of function will be addressed in this wetland alteration application; and,
- Compensation for permanent loss of wetland function will be completed through wetland restoration activities to support no net loss of wetland function, subject to NSE approval.

Project activities will result in direct mortality of vascular and non-vascular flora within the PA, in both upland and wetland habitat. Compensation, mitigation, and monitoring programs for vegetation related to wetland habitat are described in Section 6.5. The long term reclamation and remediation will involve re-vegetation of the mine site at the end of the life of the mine. Revegetation will involve establishment of native vegetation communities. Stockpiled soils will be used in reclamation efforts. This soil will contain a seedbank of native species to increase the establishment of native communities. Loss of individual plants within the Haul Road PA is expected to be permanent, as the Haul Road will not be decommissioned or reclaimed at the completion of the Project.

Construction of the Haul Road will involve decommissioning remnant pieces of the existing road, where appropriate. These remnant pieces of original road will be barricaded to prevent access and encouraged to revegetate through re-grading the soil and seeding with native seed mix, where necessary. Wetland restoration or creation will be incorporated into these areas, where appropriate.

Table 6.7-8 Mitigation and Monitoring Program for Habitat and Flora

Mitigation Type	Details	Direct Impacts	In-Direct Impacts
PRE-CONSTRUCTION			
Sediment and Erosion Control Ensure all sediment and erosion control methods are in place.	Management of silt laden water through use of silt fencing, on-site drainage control, and settling ponds.	Y	Y – to prevent silt entering unaltered habitats
	Maintain existing vegetation cover whenever possible and minimize overall areas of disturbance. Ensure contractors minimize travel across areas of exposed soils. Maintaining existing vegetation cover is the best and most cost-effective erosion control practice.	Y	Y – to prevent erosion in unaltered habitat
	Manage construction and roadway runoff through natural vegetation.	Y	Y – to prevent runoff into unaltered habitat
	Use of clean, non-ore-bearing, non-watercourse derived and non-toxic materials for erosion control methods.	Y	Y – to mitigate downgradient impacts
	Implement all erosion and sediment control practices prior to any soil disturbing activities, when applicable.	Y	Y – to mitigate downgradient impacts
	Drainage structures will be incorporated, where necessary, to dissipate hydraulic energy and maintain flow velocities sufficiently low to prevent erosion of native soil material.	Y	Y – to mitigate downgradient impacts
	Avoid frequent or unnecessary travel over erosion prone areas through communication with personnel and project planning.	Y	Y – to mitigate downgradient impacts
	Erosion and sediment control planning will be completed to ensure site runoff is not directed towards a partially impacted wetland.	Y	N
	Construction methods will consider techniques to reduce the potential to drain or flood a partially altered wetland or downgradient wetland via indirectly altered hydrology due to mine development, site dewatering, or road construction.	Y	Y – to mitigate downgradient impacts
Accidents and Malfunctions	In order to protect habitat from accidental spills, ensure that the spill control and contingency planning is in effect and its procedures fully communicated to staff.	Y	Y – to mitigate downgradient impacts

Table 6.7-8 Mitigation and Monitoring Program for Habitat and Flora

Mitigation Type	Details	Direct Impacts	In-Direct Impacts
Monitoring (see additional information in Section 6.7.7)	Complete baseline monitoring measurements and observations prior to wetland alteration activities taking place so that comparisons with post alteration conditions can be ascertained.	Y – partially altered wetlands	Y – In downgradient habitats subject to potential indirect alteration
	Communicate with contractor and Project staff the location of monitoring stations within remaining wetland habitat that is not approved for alteration.	Y – partially altered wetlands	N
Vegetation Management	Limit clearing within wetland habitat outside of approved alteration areas.	N	Y
	Vegetation management will be conducted by cutting (e.g., no use of herbicides).	Y	Y
	The slope between the edge of the mine infrastructure, roads or stockpile locations, or ditch and adjacent habitat will be re-vegetated to stabilize the slope and limit erosion and sedimentation into each adjacent habitat.	Y	Y – to mitigate potential impact to unaltered habitat
Water Management	Maintenance of pre-construction hydrological flows into and out of downstream wetland habitats and partially altered wetlands, to the extent possible (post alteration wetland monitoring may be required as a result of provincial permitting process).	Y – partially altered wetlands	Y – to mitigate downgradient impacts
Road Activity	Fugitive dust emissions can be reduced by using water trucks to suppress dust, as needed.	N	Y
	Conventional snow clearing will occur along site roads. Sand will be used to provide traction control, where necessary.	N	Y
CONSTRUCTION PHASE			
Wetland Awareness	Construction crews will follow wetland alteration and general construction schedules.	Y	N
	All work associated with wetland alterations will have site-specific terms and conditions in the Approval which must be followed.	Y	N

Table 6.7-8 Mitigation and Monitoring Program for Habitat and Flora

Mitigation Type	Details	Direct Impacts	In-Direct Impacts
	Ensure all development related activity (construction areas, access roads, etc.) are located within areas where biophysical field evaluations have been completed and approvals/written authorizations are in place as required, including work within 30 m of a wetland or watercourse.	Y	Y – to mitigate impacts to unaltered wetlands
Best Management Practices	For wetlands where infilling has been approved, limit to infill with materials permitted for use as documented within applicable approval documents.	Y	N
	Maintenance of the sediment and erosion control mitigations in place prior to each new phase of construction.	Y	Y – to mitigate impacts to unaltered wetlands
	Limit driving and use of machinery within wetland habitat where practical with use of swamp mats/corduroy bridges in wet areas to prevent rutting, diverting water flow, and sedimentation.	Y	N – no use of machinery will be permitted in unaltered wetlands
Accidents and Malfunctions	Ensure proper fuel management by establishing and implementing spill management and contingency planning	Y	Y
	A designated area for fuel storage, re-fueling, and equipment maintenance will be established at least 30 m away from any wetland or watercourse.	Y	Y – to mitigate impacts to unaltered wetlands
Vegetation Management	Maintain riparian wetland and watercourse buffers (where practical) to reduce adverse effects to wetlands, watercourses, and downstream receiving environments by clearly defining the limits of work.	Y	Y – to mitigate downgradient impacts
	Clearing of vegetation within wetlands should occur outside of the breeding bird window where possible; otherwise nesting surveys must be completed to ensure compliance with federal legislation.	Y	N – no clearing will occur in unapproved areas
	To reduce the potential for introduction of non-native species, equipment that is brought to site shall be cleaned prior to arrival and inspected for cleanliness prior to commencing work.	Y	Y

Table 6.7-8 Mitigation and Monitoring Program for Habitat and Flora

Mitigation Type	Details	Direct Impacts	In-Direct Impacts
Road Activity	Same as above	N	Y
Monitoring	Complete construction monitoring to ensure protective measures are being implemented, and review of construction after completion. Additional mitigation and monitoring measures will be determined at that time. It is anticipated that daily monitoring during construction, weekly monitoring during the operations and reclamation periods, and monthly monitoring post-reclamation will be completed;	Y	Y
DECOMMISSIONING			
Water Management	Structures and methods to manage surface water within the PA (e.g., culverts, diversion channels, settling ponds) will either be removed or will remain in position. Structures left in place post decommissioning will be evaluated for their effectiveness at maintaining hydrological conditions such that existing wetland habitat is preserved.	Y	Y
Vegetation	Upon final abandonment, areas that have erosion potential may be straw crimped and or matted and seeded to return the area to pre-disturbance conditions in a timely fashion.	Y	Y
	A reclamation program will be implemented within the mine footprint PA to re-establish native vegetation communities.	Y	Y

6.7.8 Residual Effects and Significance

The predicted residual environmental effects of Project development and production on habitat and flora are assessed to be adverse, but not significant. The overall residual effect of the Project on habitat and flora is assessed as not significant after mitigation measures have been implemented.

Table 6.7-9 Residual Environmental Effects for Habitat and Flora

Project - VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
Clearing and grubbing	Reclamation of mine footprint PA at end of Project.	A	H	PA	LT	O	R	MD	Habitat Loss	Not Significant
Heavy machinery operation	Monitor dust conditions on roads in periods with low rain. Practice spill preparedness.	A	L	PA	MT	R	R	LD	Disturbance	Not Significant
Vehicle activity for transportation of personnel and operating supplies	Monitor dust conditions on roads in periods with low rain. Practice spill preparedness.	A	L	PA	MT	R	R	LD	Disturbance	Not Significant
Widening of existing road and construction of new haul road		A	H	PA	LT	O	R	MD	Habitat Loss Disturbance	Not Significant
Haul truck activity	Monitor dust conditions on roads in periods with low rain. Practice spill preparedness.	A	L	PA	MT	R	R	LD	Disturbance	Not Significant
Vehicle activity from fleet of road trucks	Monitor dust conditions on roads in periods with low rain.	A	L	PA	MT	R	R	MD	Disturbance	Not Significant

Table 6.7-9 Residual Environmental Effects for Habitat and Flora

Project - VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
required to transport crushed ore	Practice spill preparedness.									

Legend (refer to Table 5.10-1 for definitions)

Nature of Effect		Geographic Extent		Frequency		Ecological and Social Context	
A	Adverse	PA	Project Area	O	Once	LD	Low Disturbance
P	Positive	LAA	Local Assessment Area	S	Sporadic	MD	Moderate Disturbance
		RAA Area	Regional Assessment	R	Regular	HD	High Disturbance
Magnitude				C	Continuous		
N	Negligible	**Duration**		**Reversibility**			
L	Low	ST	Short-Term	R	Reversible		
M	Moderate	MT	Medium-Term	IR	Irreversible		
H	High	LT	Long-Term				
		P	Permanent				

6.7.9 Proposed Compliance and Effects Monitoring Program

As the Project moves forward, monitoring programs will proceed to gather pre-construction habitat and flora baseline data. Monitoring programs will continue during construction, operation, and post-production to verify baseline conditions and to determine the effects of the Project on habitat and flora in the PA. Table 6.7-8 summarizes the mitigation and monitoring activities that will be completed throughout the life of the Project. The details of the monitoring programs will be determined in consultation with regulatory agencies and will be described in the application for an IA for the site operations following the EA process. High level detail is needed in this application and would be subject to review by NSE and other agencies. An EMS and EPP will be developed as part of the Project implementation that will confirm the responsibility and system of accountability for the compliance and effects monitoring program.

The objectives of the habitat and flora monitoring programs are to:

- Verify effects predicted in the EIS;
- Confirm the continuing effectiveness of mitigation measures;
- Identify the need for any new mitigation measures; and
- Confirm compliance with regulatory approvals and requirements.

Habitat and flora monitoring programs will include the following, as well as additional monitoring as determined through discussions with regulatory agencies:

- Complete baseline monitoring measurements and observations prior to wetland alteration activities taking place so that comparisons with post alteration conditions can be ascertained.
- Complete monitoring during all phases of the Project to ensure protective measures are being implemented

6.8 Terrestrial Fauna

6.8.1 Rationale for Valued Component Selection

Terrestrial fauna, and the habitat upon which they rely, may be altered either directly or indirectly by proposed Project activities. While this valued component includes understanding the potential effects of the Project on all fauna, the specific survey methods are mainly driven by identification of SAR and SOCI.

6.8.2 Baseline Program Methodology

Data collection on various fauna species was from targeted field surveys and incidental observations. Targeted surveys were completed for bats, mainland moose, and wood turtles. Incidental observations were recorded for all other fauna species including other mammals, reptiles and amphibians, and invertebrates (including freshwater molluscs, lepidopterans, and odonates). The goal of both targeted surveys and incidental observations was to understand which species are present within the PA and how they are using the PA to allow for a discussion of Project interactions and mitigation measures.

Incidental observations of mammals and various signs of mammals across the PA were documented and photographed during all field surveys. Signs included features such as dens and nests, scat, tracks, and forage evidence. Mammal observations were collected throughout the field season in 2014, 2015, and 2016. Incidental observations for priority invertebrates occurred during all field programs, particularly wetland and watercourse delineation, and fish habitat surveys. Incidental observations of odonates and lepidopterans included live adults or larvae, or cast skins. Signs of molluscs included live or dead individuals, or shells. Other than surveys associated with the mainland moose and potential bat hibernacula (e.g., AMOs) described in the following sections, no targeted mammal surveys were undertaken. Terrestrial biota methods for mainland moose and wood turtle surveys are outlined on Figures 6.8-1 and 6.8-1A to 6.8-1L. An initial habitat assessment was completed throughout the PA in October 2014 and May 2015. This initial assessment combined with a desktop analysis of priority species and ACCDC data, determined that additional specialized surveys (i.e., in addition to those mentioned above) for priority fauna species would not be required within the PA.

6.8.3 Baseline Conditions

6.8.3.1 Mammals

Incidental observations of mammal species were documented during all field surveys during 2014, 2015, and 2016 across the PA. Specific focus was given to priority species identified as having appropriate habitat within the PA. Table 6.8-1 lists those species that were confirmed within the PA either visually or by sign (scat, footprints, etc.). The presence of mainland moose, bats, and herpetofauna in the PA is described in Section 6.10.

Table 6.8-1 Confirmed mammalian species during 2014/15/16 field surveys

Common Name	Scientific Name	Sign	COSEWIC, SARA, NSESA	S Rank
Coyote	*Canis latrans*	Tracks, scat	-	S5
American Black Bear	*Ursus americanus*	Tracks, scat, digs	-	S5
White-tailed Deer	*Odocoileus virginianus*	Tracks, scat, browse	-	S5
Mainland Moose	*Alces alces americana*	Tracks	NSESA Endangered	S1
American Red Squirrel	*Tamiasciursus hudsonicus*	Seen, tracks, middens	-	S5
American Porcupine	*Erethizon dorsatum*	Seen, tracks, browse	-	S5
Snowshoe Hare	*Lepus americanus*	Seen, tracks, scat	-	S5
Beaver	*Castor canadensis*	Seen, tracks, dams, lodges, felled trees	-	S5

Table 6.8-1 Confirmed mammalian species during 2014/15/16 field surveys

Common Name	Scientific Name	Sign	COSEWIC, SARA, NSESA	S Rank
Chipmunk	*Tamias striatus*	Seen, tracks, middens	-	S5
Raccoon	*Procyon lotor*	Tracks	-	S5

Note: *The ACCDC works with provincial and federal experts to develop rarity ranks (i.e. S-ranks) for species in Nova Scotia, as well as the other Maritime Provinces, see http://www.accdc.com/en/rank-definitions.html for more information. An S-rank of S5 means that the species is Secure - Common, widespread, and abundant in the province.*

Other common mammal species, such as red fox (*Vulpes vulpes*), bobcat (*Lynx rufus*), raccoon (*Procyon lotor*), short-tailed weasel (*Mustela erminea*), American mink (*Neovison vison*), muskrat (*Ondatra zibethicus*), and striped skunk (*Mephitis mephitis*) are likely to inhabit the PA or surrounding areas, at least periodically.

6.8.3.1.1 Mainland Moose

Mainland moose have been recorded within 4.7 km of the mine footprint, and within 14.1 km of the Haul Road (ACCDC). Tracking surveys were completed for the purpose of determining the presence of moose within the PA (both mine footprint and Haul Road) as per methodology described above.

Mainland moose tracks were observed within the mine footprint PA during the dedicated PGI survey on May 24, 2015 in disturbed roadside habitat north of wetland 56. Moose tracks were also observed incidentally in two locations just outside the mine footprint PA to the northwest on September 9, 2015. These findings will be discussed further in Section 6.10.

6.8.3.1.2 Bats

According to the ACCDC reports, no known bat hibernaculae are present within 5 km of the Haul Road or mine footprint PA. The closest known bat hibernacula is located at the Lake Charlotte Gold Mine, approximately 25 km southeast of the intersection of the proposed Haul Road and Mooseland Road (approximately 45 km from the mine footprint PA) (Moseley, 2007).

Provincial government records of AMOs were reviewed within the boundary of the PA, as these AMOs potentially provide bat hibernacula. Twelve AMOs were identified within the PA and 99 were identified within a 10 km buffer of the Haul Road. A desktop review (described above) identified that the cluster of 99 AMOs located 6.4 km from the Haul Road PA do not provide potential bat hibernacula. Twelve AMOs within the mine footprint PA were evaluated for their potential to provide bat hibernacula on September 18, 2014. Of the 20 AMOs evaluated at the site, all were either in-filled, contained a concrete cap blocking access, or were flooded, with the exception of one (BED-1-003), which was identified during the desktop evaluation as a potential bat hibernaculum. This AMO known as the J.H. Austin Main Shaft (AMO Database BED-1-003; NSDNR, 2010) is located on Beaver Dam Road, Halifax County at UTM Zone 20, 522256 Easting and 4990298 Northing. It is located just east of the Beaver Dam Mine Access Road at the western end of the existing settling pond southwest of Cameron Flowage. The locations of AMOs are shown on Figure 6.8-1. It was determined to be inaccessible to bats, as described further in Section 6.10.3.4.

6.8.3.2 Herpetofauna

Herpetofaunal species were inventoried within the PA through both targeted searches of appropriate habitats and through incidental observations. Specialized survey methods used to identify wood turtles and their habitat are described above.

Species that have been observed, either directly or indirectly (through vocalizations, egg masses, cast snake skins, etc.) within the PA during the various field programs completed throughout the site, (primarily wetland and watercourse assessments) are provided in Table 6.8-2.

Table 6.8-2 Observed species during 2014/15/16 field surveys

Scientific Name	Common Name	SRank
Bufo americanus americanus	Eastern American Toad	S5
Lichlorophis vernalis vernalis	Eastern Smooth Green Snake	S5
Notophthalmus viridescens viridescens	Red-spotted Newt	S5
Plethodon cinereus	Red-backed Salamander	S5
Pseudacris crucifer crucifer	Spring Peeper	S5
Rana catesbeiana	Bull Grog	S5
Rana clamitans melanota	Green Frog	S5
Rana pipiens	Northern Leopard Frog	S5
Rana sylvatica	Wood Frog	S5
Thamnophis sirtalis pallidulus	Maritime Garter Snake	S5

Though not observed, it is likely that other common herpetile species use habitat within the PA, at least periodically. These species include the painted turtle (*Chrysemys picta picta*), mink frog (*Rana septentrionalis*), pickerel frog (*Rana palustris*), yellow-spotted salamander (*Ambystoma maculatum*), northern red-bellied snake (*Storeria occipitomaculata occipitomaculata*), and northern ring-necked snake (*Diadophis punctatus edwardsii*).

The snapping turtle (*Chelydra serpentina serpentina,* SARA Special Concern, NSESA Vulnerable, S3) was not observed within the mine footprint PA. It was, however, observed within the vicinity of the PA and along the current road to the Touquoy mine site within the Haul Road PA (See Figures 6.10-2 and 6.10-2A to 6.10-2L). Suitable habitat for the snapping turtle was observed within the PA. This species will be discussed further in Section 6.10.

6.8.3.3 Summary of Fauna and Habitat within the PA

The variety of both upland and wetland habitats identified throughout the PA support a range of terrestrial fauna. The PA is located in a relatively remote, undeveloped landscape. Timber harvesting and associated forestry roads form the dominant disturbance regime within the landscape surrounding the PA. This land use within and surrounding the PA has created edge habitats and openings in the canopy coverage to provide foraging opportunities for species such as white-tailed deer, black bears, and coyote. Evidence of these species, along with snowshoe hare and porcupine, were abundant in disturbed habitats throughout the PA. Beavers and beaver activity has been observed in multiple waterbodies within the PA, particularly within Crusher Lake. All of the mammal species identified within the PA are presumed to use parts of the PA for foraging, breeding, denning, and raising young, at least periodically.

Herpetofauna species were observed throughout the PA, generally in association with an aquatic ecosystem, such as wetlands, waterbodies, and watercourses. Where improperly installed culverts are present along the existing Haul Road, many wetlands have standing water which has backed up as a result of improper culvert installation. These open-water wetlands, and natural wetlands with similar hydrologic regimes, are known to support breeding and overwintering populations of a variety of herpetofauna observed within the PA.

Incidental sightings of fauna were recorded during all field programs throughout the PA during all seasons. Aside from mainland moose tracks and a sighting of a snapping turtle, no priority fauna species or signs thereof were observed. Given the mobility of fauna species, the absence of observation does not confirm absence of the species within the PA. The size of a species and a species' behavior can result in a bias against detection. For instance, very small species, such as the maritime shrew (S3) and the rock vole (S2) have been documented within 5 km of the PA, but were not observed by the Project Team within the PA. As another example, the fisher (*Martes pennanti,* S2) is a largely nocturnal hunter, with large home ranges and elusive behavior. They prefer dense, mature to over-mature coniferous stands with large hollow snags for den sites. Their preferred habitat and prey items (porcupine, rabbits, squirrels and other small mammals) are present within the PA. The lack of observed evidence of fisher does not confirm absence of the species. Furthermore, weather conditions can affect the detectability of species. Rain or snow can wash away or cover animal tracks and scat, while temperature affects the activity levels of herpetofauna and, therefore, their detectability. When there is a thermal advantage to staying under water or immersed in wetland vegetation, herpetofauna can be more difficult to detect, compared with warmer days when they can be found basking in the sun.

Aside from direct habitat loss within the mine footprint PA, the Project may affect terrestrial fauna through the increase in traffic along the Haul Road during operation. According to Fahrig and Rutwinski (2009), road construction can have relatively high negative impacts on amphibians and reptiles, and large mammals, compared with small mammals and birds. Road infrastructure and traffic have a negative impact on those species which are attracted to roads, but lack the speed or cognitive ability to avoid traffic (e.g., turtles attracted to gravel roadsides for nesting). Small mammals and birds, on the other hand, are able to avoid collisions with vehicles in general. Amphibians in particular can benefit from culvert installation where wetlands and watercourses intersect roads, as an alternative to crossing the roads, because this group can experience high mortality (Bouchard et al., 2009).

Road construction can decrease habitat quality through direct habitat loss, degradation, and fragmentation (Underhill and Angold, 2000). For some species (e.g., porcupine), the construction of a road can be beneficial by providing new foraging opportunities. Species that rely on interior forest conditions (e.g., fisher) are likely to avoid areas with new road construction in favor of more undisturbed habitats. Local level changes in abundance and distribution of species may occur as the result of Project activities, but it is not anticipated than any of these changes will result in changes in overall fauna populations. While some direct loss of habitat will occur, the PA is located in an undeveloped, natural landscape with a diversity of habitats. Habitat present within the PA is not unique or rare in the local or regional context.

6.8.4 Consideration of Consultation and Engagement Results

Key issues raised during public consultation and Mi'kmaq engagement relating to terrestrial fauna include potential effects on fauna from permanent loss of habitat associated with the footprint of the Beaver Dam Mine site and haul road, as well as direct mortality associated with the hauling operation. Potential effects on traditional uses of land and resources by the Mi'kmaq were noted, including hunting and trapping of small game and deer.

The results of the public consultation and Mi'kmaq engagement have been considered in the environmental effects assessment, including the Proponent's commitments on mitigation and monitoring measures and proposed compliance and effects monitoring programs, as well as the Proponent's broader commitment to ongoing public consultation and Mi'kmaq engagement. Specific to evaluating the effect on terrestrial fauna, these are found within the following environmental effects assessment.

6.8.5 Effects Assessment Methodology

6.8.5.1 Boundaries

Spatial Boundaries

The spatial boundaries used for the assessment of effects to terrestrial fauna are the PA for the mine footprint and the haul road. The LAA consists of any habitat contiguous and consistent with habitat available within the PA. These spatial boundaries will help to identify the direct or indirect impacts to terrestrial fauna species and habitats.

Temporal Boundaries

The temporal boundaries used for the assessment of effects to terrestrial fauna are the construction phase, operational phase, and decommissioning and reclamation phase.

Technical Boundaries

No technical boundaries were identified for the effects assessment of terrestrial fauna.

Administrative Boundaries

Administrative boundaries for management of terrestrial fauna include the Nova Scotia Wildlife Act, which protects wild species diversity and abundance, and the Canada Wildlife Act. Further protection is offered to SAR through the provincial Nova Scotia Endangered Species Act and the federal SARA.

6.8.5.2 Thresholds for Determination of Significance

A significant adverse effect from the Project on terrestrial fauna is defined as an effect that is likely to cause a permanent alteration to any fauna species distribution or abundance, or alteration of core habitat. An adverse effect that does not cause a permanent alteration in distribution or abundance of terrestrial fauna species is considered to be not significant.

6.8.6 Project Activities and Fauna Interactions and Effects

Table 6.8-3 Potential Terrestrial Fauna Interactions with Project Activities at Beaver Dam Mine Site

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Clearing, grubbing, and grading in preparation of construction • Rock blasting in preparation of construction • Till and waste rock from site preparation transport and storage • Watercourse and wetland alteration in preparation of construction • Mine site road construction • Surface infrastructure installation and construction • Collection and settling pond construction • Environmental monitoring of surface water discharges and adjacent wetlands • Accidents and malfunctions to include fuel and other spills, forest fires, settling pond overflow, slope failure, an unplanned explosive event, and a mobile equipment accident
Operation and Maintenance	3-4 years	• Rock blasting to access and extract ore • Management of waste rock produced from crushing and preparing ore for transport • Treatment of site surface water runoff and surface mine pumped water • Environmental monitoring of surface water discharges and adjacent wetlands • General management of wastes derived from operation and maintenance activities • Accidents and malfunctions to include fuel and other spills, forest fires, settling pond overflow, slope failure, an unplanned explosive event, and a mobile equipment accident
Decommissioning and Reclamation	1-2 years	• Site reclamation activities • Environmental monitoring of adjacent wetlands • General management of wastes derived from decommissioning and reclamation activities • Accidents and malfunctions to include fuel and other spills, forest fires, and mobile equipment accidents

Table 6.8-4 Potential Terrestrial Fauna Interactions with Project Activities along Haul Road

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Clearing, grubbing, and grading in preparation of construction • Rock blasting in preparation of construction • Till and waste rock from site preparation transport and storage • Watercourse and wetland alteration in preparation of construction • Haul road construction and upgrades • Environmental monitoring of adjacent wetlands • General management of wastes derived from preparation and construction activities • Accidents and malfunctions to include fuel and other spills, forest fires, and a haul truck accident
Operation and Maintenance	3-4 years	• Ore transport • Haul road maintenance and repairs, including snow removal and deposition of sand for traction control • Environmental monitoring of adjacent wetlands • Trucking ore from mine footprint to Touquoy Processing Facility • Accidents and malfunctions to include fuel and other spills, forest fires, and a haul truck accident
Decommissioning and Reclamation	-	N/A[1]

[1] Decommissioning and Reclamation of the haul road is not expected. The haul road will be returned to owner for forestry industry

Table 6.8-5 Potential Terrestrial Fauna Interactions with Project Activities at Touquoy Processing and Tailings Management Facility

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Accidents and malfunctions to include fuel and other spills, forest fires, and mobile equipment accidents
Operation and Maintenance	3-4 years	• Environmental monitoring • General management of waste derived from processing activities • Accidents and malfunctions to include fuel and other spills, forest fires, and a haul truck accident

Project Phase	Duration	Relevant Project Activity
Decommissioning and Reclamation	1-2 years	• Environmental monitoring • Accidents and malfunctions to include fuel and other spills, and forest fires

Development of the mine infrastructure and upgrades to the haul road will cause direct impacts to habitat used by terrestrial fauna, including upland forested habitat and wetlands. This will occur mostly within the construction phase of the Project. Habitat within the PA and surrounding landscape currently exhibits fragmented conditions based on historic mine operations, existing road and trail networks, and current and historic timber harvesting activity within and adjacent to the PA. Project activities are likely to result in increased habitat fragmentation and a decrease in habitat quality for those species which rely especially on interior forest conditions, where intact interior forest remains. This decrease in habitat quality for species relying on interior forest condition is based on increased activity and sensory disturbance, along with increased physical fragmentation. Increase in physical fragmentation is expected to be low, based on the current high level of disturbed habitat as discussed.

Sensory disturbance to terrestrial fauna would result from rock blasting, clearing and grubbing, infrastructure construction, and overall increased traffic along the entire haul route during operations. This will likely result in the localized wildlife avoidance of the PA. Overall, Project activities will likely cause a change in usage of the PA by wildlife, with some species tending to avoid the area, while others may be attracted to the increased activity, including opportunistic species such as coyotes, raccoons, skunks, or black bears. Sensory disturbance related to Project activity will occur within the mine footprint PA, Haul Road PA, and within the Touquoy Processing Facility, as the addition of material from the Beaver Dam mine will extend the life of the Touquoy Processing Facility by four years.

Changes to ambient noise levels and the presence of periodic vibrations from blasting have the potential to adversely affect fauna and birds by influencing migration and behavioral patterns. Noise and vibration is provincially regulated via the *Workplace Health and Safety Regulations* and the *Pit and Quarry Guidelines*, which protect the health of site workers and the general public at PA boundaries, respectively. If blasting is required near fish-bearing watercourses or waterbodies, guidelines identified by Wright and Hopky (1998) will be provided to site personal and contractors, and adhered to as part of the Beaver Dam EPP.

Direct mortality of fauna species could result from Project activities, particularly due to the increase in traffic during construction and operation of the facility. Increased traffic poses a risk to wildlife along the entire length of the Haul Road between the Beaver Dam mine footprint and the Touquoy processing facility. Indirect mortality could result from exposure to contaminants or spills from unplanned incidents.

Table 6.8-6 Project Interactions for Fauna

Impact Type	Direct Impact	Project Phase1	Indirect Impact	Project Phase1
Vegetative and Habitat Integrity	Loss of vegetative cover decreases wildlife habitat availability and also has the potential to reduce natural surface water drainage.	C	Habitat fragmentation may alter habitat suitability for those species which rely on interior forest conditions. Within the Haul Road PA, this change in habitat is expected to be permanent.	C O D
Sensory Disturbance	Extensive ground works, including activities such as blasting will increase noise levels. Increase in vehicular traffic will add to sensory disturbance through increased noise. This has the potential to reduce habitat for fauna.	C O D	Sensory disturbance (both lights and sounds) may result in further avoidance of the PA by some species.	C O
	Project infrastructure and roads will have lights which are operational at all times, which can alter habitat quality and sleep/wake cycles within the immediate vicinity of the PA. This may decrease efficiency of nocturnal hunters.	C O	Some opportunistic wild species may be attracted to the site as a result of increased access and available food sources (natural prey or anthropogenic food sources), potentially increasing interactions between site personnel and wildlife.	C O
Direct Mortality	Increased traffic and general activity within the PA may result in direct mortality to wild species through vehicular collisions and construction.	C O D	Improved access throughout the PA may increase hunting activity of licensed hunters and/or illegal poachers.	C O D

The current condition of the mine footprint is disturbed and fragmented habitat based on timber harvesting and historic mining activity. The level of disturbance within the mine footprint PA disproportionately affects uplands over wetlands. Large, natural, undisturbed wetland habitats do exist within the mine footprint PA (particularly wetlands 2 and 29). A network of roads and trails is present throughout the site, with parts of the mine footprint PA characterized by un-vegetated gravel and crushed stone, and a large fabricated settling pond used during mining activities (wetland 59) exists in the mine footprint PA. Based on a visual review of a 2014 aerial photograph and the NSDNR Forest Inventory, approximately 78.6% of the PA is currently disturbed. Disturbed areas consist of clearcutting (4.6%), forested less than 40 years (51.3%), forested between 40 and 100 years (5.7%), mining and exploration activities (14.5%), and road corridors (2.5%). The remaining 21.4% of the PA is considered to be undisturbed wetlands (10.4%) and forests (11.1%) (NSDNR 2017). As such, the level of new fragmentation associated with the mine footprint PA is anticipated to be moderate, given the current level of disturbance. Those species which prefer interior forest conditions (e.g., fisher) are likely already avoiding the mine footprint PA, while those species which prefer fragmented habitat (e.g., coyote, snowshoe hare, white-tailed deer) are not expected to be adversely affected by additional habitat fragmentation.

Construction of the haul road will involve a combination of new road construction (4.0 km) and upgrades to the existing logging road. The majority of the proposed Haul Road (99%) follows an existing road corridor, thereby limiting new habitat fragmentation. The existing Haul Road is used by lumber trucks, but the level of traffic varies seasonally and annually depending on which areas are undergoing timber harvesting. One 4 km portion of new road construction is required. The section of road immediately southwest of Highway 224 will add new habitat fragmentation to an area that has very little, if any, evidence of anthropogenic disturbance. The construction of this section of the Haul Road will decrease the habitat quality for those species that rely on interior forest.

The effect of the Project on wildlife can largely be attributed to sensory disturbance. Traffic volumes on the existing Haul Road are unknown and variable both seasonally and annually. Project activities will increase the traffic levels by an average of 20 trucks per day for 12-16 hours of the day during the operational phase of the Project (an annual average of approximately 185 return truck trips per day). Additionally, blasting will occur 1-2 times per week within the mine footprint during the operational phase. This represents a considerable increase in sensory disturbance above current conditions, and will likely reduce the habitat quality for some species.

The increased level of traffic poses an increased risk to wildlife collisions, particularly along the Haul Road, where the speed limit is proposed to be 70 km/hr. The risk of collisions within the mine footprint will be lower, as the speed limit will be reduced to 50 km/hr., giving both drivers and wildlife more reaction time to avoid collisions. While no obvious wildlife corridors were observed within the PA, it is anticipated that some wild species (e.g., herpetofauna) will use watercourses and wetland complexes as travel corridors, thereby increasing the risk of collisions with wildlife along these systems where they interact with the Haul Road and interior mining roads. The risk of collisions with wildlife will vary depending on the season and the species. For instance, during winters with deep snow conditions, white-tailed deer are more likely to use roads and trails, putting them at an elevated risk of collisions. During spring and summer, porcupine and skunks forage on roadside vegetation at dawn and dusk, increasing the risk of collisions with those species, and turtles are drawn to the roadside to nest in the gravelly shoulders in June. As such, the risk of wildlife collisions is present at any time of year.

The Touquoy facility is currently under construction. There are no direct or indirect effects to terrestrial fauna anticipated to be caused by the processing of ore and the management of tailings from the Beaver Dam Mine Project as no increase in footprint is proposed beyond the approved construction now underway. No effects are anticipated at the Touquoy facility related to the processing of Beaver Dam ore, with the exception of the continued potential for accidents and malfunctions and continued environmental monitoring.

6.8.7 Mitigation and Monitoring

In order to mitigate and reduce overall loss of function of habitat used by terrestrial fauna, and reduce direct impacts on fauna, the following actions will be implemented where direct loss of habitat is expected to support mine and Haul Road development:

- Intact forest stands and wetlands will be avoided wherever possible during detailed Project planning and design in favor of previously disturbed areas (e.g., stands disturbed by timber harvesting);

- Where natural, intact habitat cannot be avoided, minimization of total Project footprint will be considered during planning;
- Habitat fragmentation will be reduced by limiting the area of new roads, favoring upgrading of existing roads where possible instead;
- Site infrastructure will be fenced in, where practical, to reduce interactions between Project infrastructure and wildlife;
- A speed limit of 50 km/hr. within the mine footprint and 70km/hr. along the Haul Road will be implemented to reduce likelihood of collisions with fauna;
- An un-vegetated buffer along roadsides will be maintained, where possible, to improve visibility along roadsides and reduce the potential for collisions with wildlife;
- Clearing and construction will be limited within wetlands that could support snapping turtles during winter hibernation period;
- Culverts installed within wetlands and watercourses will provide an alternative crossing location to amphibians and reptiles, thereby reducing direct mortality of species attempting to cross a road;
- Watering of roads during dry conditions will occur to improve safety and visibility and reduce likelihood of collisions between vehicular traffic and wildlife;
- Site-specific measures to protect wildlife will be addressed in the EPP;
- Waste must be managed to reduce attractants to opportunistic wildlife species;
- Proper handling of hazardous wastes will reduce exposure to contaminants as a result of unplanned incidents;
- Erosion and sediment control planning will be completed to ensure site runoff is not directed towards unaltered habitat;
- For those species reliant on wetland habitat, a wetland alteration application will be submitted during Project planning and designed to request an authorization to alter wetland habitat. Loss of function and habitat will be addressed in this wetland alteration application; and
- Compensation for permanent loss of wetland function will be completed through wetland restoration activities to support no net loss of wetland function, subject to NSE approval.

Where direct impacts to habitat are not expected, the mine and Haul Road development may be potentially affected by indirect impacts from construction, operation, and decommissioning of the mine. The following actions will be implemented to reduce the potential for indirect impacts to adjacent undisturbed habitat:

- For species which rely on wetland habitat, maintain pre-construction hydrological flows into and out of downstream wetland habitats, to the extent possible (post alteration wetland monitoring may be required as a result of the provincial permitting process);
- In order to protect adjacent habitats from accidental spills, ensure that spill control and contingency planning is in effect, and its procedures fully communicated to staff;

- Vegetation management will be conducted by cutting (i.e., no use of herbicides);
- Ensure all development related activity (construction areas, access roads, etc.) are located within areas where biophysical field evaluations have been completed and approvals/written authorizations are in place as required;
- Erosion control materials shall be clean, non-ore-bearing, non-watercourse derived and non-toxic materials;
- Machinery and personnel will be instructed not to enter the habitats outside of approved Project footprint; and
- Slopes will be re-vegetated to stabilize them and limit erosion and sedimentation into adjacent habitats.

Table 6.8-7 Mitigation and Monitoring Programs for Fauna

Mitigation Type	Details	Direct Impacts	In-Direct Impacts
PRE-CONSTRUCTION			
Wetland Awareness Mitigation outlined for wetland awareness will also mitigate impacts on species which rely on wetland habitat	- Complete pre-construction site meetings with relevant construction staff to educate staff to the locations of wetlands and policies related to working around wetlands and watercourses to limit disturbance to those wild species which rely on wetland and aquatic habitat; - Identify and communicate schedule of construction activities as it relates to alteration of wetland habitat; - Provide copies of relevant maps and digital format locations of wetlands as well as approvals and terms and conditions as they pertains to wetlands to the contractor; - Ensure wetland boundary flagging tape is in place prior to construction activities taking place; - Ensure all development related activities (construction areas, access roads, etc.) are located within areas where biophysical field evaluations have been completed and approvals/written authorizations are in place as required, including work within 30 m of a wetland or watercourse; and - Machinery and personnel will be instructed not to enter wetlands outside of approved alteration areas.	Y	Y
Sediment and Erosion Control	Management of silt laden water through use of silt fencing, on-site drainage control, and settling ponds.	Y	Y

Table 6.8-7 Mitigation and Monitoring Programs for Fauna

Mitigation Type	Details	Direct Impacts	In-Direct Impacts
Ensure all sediment and erosion control methods are in place to protect fauna species which rely on wetland habitat. Methods specifically relevant to working in proximity to wetlands including:	Maintain existing vegetation cover whenever possible and minimize overall areas of disturbance. Ensure contractors minimize travel across areas of exposed soils. Maintaining existing vegetation cover is the best and most cost-effective erosion control practice.	Y	Y
	Manage construction and roadway runoff through natural vegetation.	Y	Y
	Use of clean, non-ore-bearing, non-watercourse derived, and non-toxic materials for erosion control methods.	Y	Y
	Implement all erosion and sediment control practices prior to any soil disturbing activities, when applicable.	Y	Y
	Drainage structures will be incorporated, where necessary, to dissipate hydraulic energy and maintain flow velocities sufficiently low to prevent erosion of native soil material.	Y	Y
	Avoid frequent or unnecessary travel over erosion prone areas through communication with personnel and project planning.	Y	Y
	Erosion and sediment control planning will be completed to ensure site runoff is not directed towards a partially impacted wetland.	Y	Y
	Construction methods will consider techniques to reduce the potential to drain or flood a partially altered wetland or downgradient wetland via indirectly altered hydrology due to mine development, site dewatering, or road construction.	Y	Y
Accidents and Malfunctions	In order to protect fauna reliant on wetland habitat from accidental spills, ensure that the spill control and contingency planning is in effect and its procedures fully communicated to staff.	Y	Y
	Speed limits within the mine footprint and Haul Road will be implemented at 50 km/hr. and 70 km/hr., respectively, to reduce potential collisions with fauna.	Y	N

Table 6.8-7 Mitigation and Monitoring Programs for Fauna

Mitigation Type	Details	Direct Impacts	In-Direct Impacts
	Road conditions will be monitored and managed through dust suppression and traction control (sand on icy roads) to reduce potential for collisions with wildlife. Vegetation will be cleared within a 10 m buffer of roadsides, where possible, to improve visibility and reduce wildlife collisions.	Y	N
Vegetation Management	Limit clearing to approved areas.	N	Y
	Vegetation management will be conducted by cutting (i.e., no use of herbicides).	Y	Y
	The slope between the edge of the mine infrastructure, roads or stockpile locations, or ditch and adjacent wetlands will be re-vegetated to stabilize the slope and limit erosion and sedimentation into adjacent habitats.	N	Y
	Wetlands will be avoided wherever possible during detailed Project planning and design.	Y	Y
CONSTRUCTION PHASE			
Wetland Awareness	Construction crews to adhere to wetland alteration and general construction schedules.	Y	N
	All work associated with wetland alterations will have site-specific terms and conditions in the Approval which must be adhered to.	Y	N
	Ensure all development related activities (construction areas, access roads, etc.) are located within areas where biophysical field evaluations have been completed and approvals/written authorizations are in place as required, including work within 30 m of a wetland or watercourse.	Y	Y
Best Management Practices	For wetlands where infilling has been approved, limit to infill with materials permitted for use as documented within applicable approval documents.	Y	N
	Maintenance of the sediment and erosion control mitigations in place prior to each new phase of construction.	Y	Y

Table 6.8-7 Mitigation and Monitoring Programs for Fauna

Mitigation Type	Details	Direct Impacts	In-Direct Impacts
	Limit driving and use of machinery within wetland habitat where practical with use of swamp mats/corduroy bridges in wet areas to prevent rutting, diverting water flow, and sedimentation.	Y	N
	Habitat fragmentation will be reduced by upgrading existing roads wherever possible, instead of building new roads.	N	Y
	Hazardous and non-hazardous waste will be stored in designated locations, in appropriate containers to reduce potential for spills, and to prevent attracting wildlife (e.g., food waste in bear proof containers)	Y	Y
	Wildlife awareness training will be provided to all site personnel during site-specific orientation. Wildlife awareness training will include measures to reduce interactions between site personnel and wild species and reporting of poaching activity within the vicinity of the PA.	N	Y
	Fencing will be installed, where practical, to prevent wildlife from accessing areas with increased risk of injuries to wild species.	Y	N
	Implement a wildlife reporting protocol so wildlife activity can be tracked throughout the PA. This information can be used to install signage, if appropriate, in areas with high wildlife sightings.	Y	N
Accidents, Malfunctions and Sensory Disturbance	Ensure proper fuel management by establishing and implementing spill management and contingency planning.	Y	Y
	Fuel will be stored in designated areas only. Re-fueling and maintenance will occur in designated areas wherever possible.	N	Y
	Adherence with the Pit and Quarry Guidelines, and Guidelines for use of Explosives in or Near Canadian Fisheries waters (Wright and Hopky, 1998) will be adhered to, wherever possible, to reduce impact of noise and vibration on wild species.	Y	Y

Table 6.8-7 Mitigation and Monitoring Programs for Fauna

Mitigation Type	Details	Direct Impacts	In-Direct Impacts
	The use of lights will be limited to the amount necessary to ensure safe operation within the PA, with the recognition that excessive lighting can be disruptive to wild species.	N	Y
	Limits blasting during evenings and weekends to allow some time for wild species to recover from the noise disturbance.	Y	Y
Vegetation Management	Maintain riparian wetland and watercourse buffers (where practical) to reduce adverse effects to wetlands, watercourses, and downstream receiving environments by clearly defining the limits of work.	Y	Y
	Measures to reduce the spread of invasive species (such as cleaning and inspecting vehicles) will be employed wherever possible to maintain the quality of remaining habitat.	N	Y
Monitoring	Complete regular construction observations to ensure protective measures are being implemented.	Y	Y
DECOMMISSIONING			
Water Management	Structures and methods to manage surface water within the PA (e.g., culverts, diversion channels, settling ponds) will either be removed or will remain in position. Structures left in place post decommissioning will be evaluated for their effectiveness at maintaining hydrological conditions such that existing wetland habitat is preserved.	Y	Y
Vegetation	Upon final abandonment, areas that have erosion potential may be straw crimped and or matted and seeded to return the area to pre-disturbance conditions in a timely fashion.	Y	Y
	Implement the remediation plan to re-establish native vegetation communities within the mine footprint PA.	Y	Y
Monitoring	Monitoring of remedial activities to evaluate their success in establishing habitat for wild species and monitoring wetlands for condition and integrity may be necessary post decommissioning phase.	Y	N

6.8.8 Residual Effects and Significance

The predicted residual environmental effects of Project development and production on terrestrial fauna are assessed to be adverse, but not significant. The overall residual effect of the Project on terrestrial fauna is assessed as not significant after mitigation measures have been implemented.

Table 6.8-8 Residual Environmental Effects for Fauna

Project - VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context	Residual Effect	Significance of Residual Effect
Clearing and grubbing	Stockpile topsoil for remedial efforts upon mine completion	A	L	PA	MT	O	R	MD	Habitat Loss	Not Significant
Heavy machinery operation	Implement speed limits to reduce potential collisions with wild species	A	L	PA	MT	R	IR	LD	Disturbance , direct mortality	Not Significant
Vehicle activity for transportation of personnel and operating supplies	Implement speed limits to reduce potential collisions with wild species	A	L	PA	MT	R	R	LD	Disturbance, direct mortality	Not Significant
Construction and commissioning of support infrastructure	Install fences where practical to prevent wildlife access into areas with working equipment	A	L	PA	MT	O	R	LD	Disturbance	Not Significant
Widening of, and upgrades to existing haul road	Upgrade existing road where possible to limit the footprint of new construction	A	M	PA	LT	O	R	MD	Habitat Loss	Not Significant
Open pit lighting	Minimize lighting wherever possible	A	L	PA	MT	R	R	LD	None	Not Significant
Blasting (once per week) and drilling of in-situ rock	Follow guidelines for blasting outlined by the Pit and Quarry Guidelines	A	L	PA	MT	R	R	LD	Disturbance	Not Significant
Haul truck activity	Implement and enforce speed limit to	A	M	PA	MT	R	R	LD	Disturbance Direct Mortality	Not Significant

Table 6.8-8 Residual Environmental Effects for Fauna

Project - VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context	Residual Effect	Significance of Residual Effect
	reduce potential for collisions with wildlife									
Primary crushing of ore	Install fencing, if practical, to prevent wildlife from entering crusher area	A	L	PA	MT	R	R	MD	Disturbance	Not Significant

Legend (refer to Table 5.10-1 for definitions)

Nature of Effect
A Adverse
P Positive

Magnitude
N Negligible
L Low
M Moderate
H High

Geographic Extent
PA Project Area
LAA Local Assessment Area
RAA Regional Assessment Area

Duration
ST Short-Term
MT Medium-Term
LT Long-Term
P Permanent

Frequency
O Once
S Sporadic
R Regular
C Continuous

Reversibility
R Reversible
IR Irreversible

Ecological and Social Context
LD Low Disturbance
MD Moderate Disturbance
HD High Disturbance

6.8.9 Proposed Compliance and Effects Monitoring Program

As the Project moves forward, monitoring programs will proceed to gather pre-construction terrestrial fauna baseline data. Monitoring programs will continue during construction, operation, and post-production to verify baseline conditions and to determine the effects of the Project on habitat and flora in the PA. Table 6.8-7 summarizes the mitigation and monitoring activities that will be completed throughout the life of the Project. The details of the monitoring programs will be determined in consultation with regulatory agencies and will be described in the application for an IA for the site operations following the EA process. High level detail is needed in this application and would be subject to review by NSE and other agencies. An EMS and EPP will be developed as part of the Project implementation that will confirm the responsibility and system of accountability for the compliance and effects monitoring program.

The objectives of the terrestrial fauna monitoring programs are to:

- Verify effects predicted in the EIS;
- Confirm the continuing effectiveness of mitigation measures;
- Identify the need for any new mitigation measures; and
- Confirm compliance with regulatory approvals and requirements.

Terrestrial fauna monitoring programs will include the following, as well as additional monitoring as determined through discussions with regulatory agencies:

- Complete regular construction monitoring to ensure protective measures are being implemented; and
- Monitoring of remedial activities to evaluate their success in establishing habitat for wild species, and monitoring wetlands for condition and integrity may be necessary post decommissioning phase.

6.9 Birds

6.9.1 Rationale for Valued Component Selection

Bird habitat may be altered or lost as a result of direct or indirect disturbances from the Project. Migratory birds and SAR are protected under federal legislation by the Migratory Birds Convention Act (MBCA) (Government of Canada, 1994) and SARA (Government of Canada, 2002). The *Nova Scotia Wildlife Act* protects all birds within the province by stating that, except with a permit issued by the minister, *no person shall destroy, take, possess, buy or sell any egg of a bird or turtle or disturb the nest of a bird or turtle; or use a snare, net or trap to take any bird* (Government of Nova Scotia, 1989, Section 51).

6.9.2 Desktop Review

A background review of potential avian species that could occur within the PA was completed prior to the start of the baseline monitoring programs. Table 6.9-1 presents the data sources that were used. Results and sources for the Priority Species Assessment will be discussed in Section 6.10.3.7.

Table 6.9-1 Data Sources for the Background Review

Task	Source(s)	Product
Breeding Bird Identification	• Second MBBA	Identification of bird species considered confirmed breeders within 10 km of the PA.
Priority Species Assessment*	• ACCDC • Committee on the Status of Endangered Wildlife in Canada (COSEWIC) • SARA • Nova Scotia Endangered Species Act (NS ESA) • Museum of Natural History report • Habitat mapping for the site	A priority list for SAR and SOCI with suitable habitat inside the PA and a list of species identified near the PA by ACCDC.
Important Bird Areas	• Important Bird Areas of Canada	Description of nearest Important Bird Area to the Beaver Dam PA.

Note: *Priority species and the associated desktop analyses will be discussed in Section 6.10.

6.9.2.1 Maritime Breeding Bird Atlas

The PA encompasses four MBBA squares: 20NQ17, 20NQ18, 20NQ28, and 20NQ29 (Stewart et al., 2015). Table 6.9-2 presents a summary of results for the four 10 km x 10 km MBBA (2006-2010) squares:

Table 6.9-2 Results Summary for MBBA Squares 20NQ17, 20NQ18, 20NQ28 and 20NQ29

Atlas Square*	Approximate Location in Project Area	Species (2nd Atlas)			
		No. Possible Breeders	No. Probable Breeders	No. Confirmed Breeders	Total
20NQ17	Southern end of the Haul Road PA, including Mooseland Road and the unnamed road that goes up to Highway 224, but only until near Rum Lake.	31	16	26	73

Table 6.9-2 Results Summary for MBBA Squares 20NQ17, 20NQ18, 20NQ28 and 20NQ29

Atlas Square*	Approximate Location in Project Area	Species (2nd Atlas)			
		No. Possible Breeders	No. Probable Breeders	No. Confirmed Breeders	Total
20NQ18	Includes Haul Road PA from near Rum Lake until Highway 224, about half of the new road section (western) and half the length of Highway 224 (western) between the unnamed road and Beaver Dam Mines Road.	11	19	52	82
20NQ28	Includes the eastern halves of Highway 224 and the new road section, as well as Beaver Dam Mines Road until mid-way through the Mine Footprint PA.	20	28	21	69
20NQ29	Includes the northern half of the Mine Footprint PA.	20	22	35	77

Note: Data is from the 2nd atlas (2006-2010).

The MBBA data summaries for squares 20NQ17, 20NQ18, 20NQ28, and 20NQ29 can be found in **Appendix L**, along with bird species codes and breeding evidence codes.

6.9.2.2 Important Bird Areas

The nearest (IBA) is the Eastern Shore Islands, located approximately 22 km southeast of the PA. The Eastern Shore Islands are situated along the southeast coast of central Nova Scotia, between 60 and 120 km east of Halifax. The site includes inshore islands roughly located between Clam Harbour and Ecum Secum. Within this rock-strewn stretch of sea are many low islands, islets, and reefs located between 2 and 15 km offshore. The vegetation on these islands varies from mostly wooded to treeless. The Eastern Shore Islands IBA supports large congregations of common eiders (*Somateria mollissima*), representing more than 2.5% of the subspecies population, as well as a wintering population of harlequin ducks (*Histrionicus histrionicus*). Other waterfowl frequent the site during spring migration, including thousands of scoters, and Leach's storm-petrels (*Oceanodroma leucorhoa*) also breed on some of the islands. (IBA Canada, n.d.). Habitat present within the PA is not consistent with habitat present on the Eastern Shore Islands. Furthermore, the PA is located a sufficient distance from the nearest IBA and is not located within a significant migratory flyway for species which rely on the Eastern Shore Islands.

6.9.2.3 Baseline Program Methodology

Avian baseline monitoring programs were completed by MEL and included the surveys outlined in Table 6.9-3.

Table 6.9-3 Avian Baseline Monitoring within the PA

Survey Type	PA	
	Mine Footprint PA	Haul Road PA
Fall migration monitoring	September 17 - October 19, 2014 Thirty-two (32) point count stations Four (4) visits - weekly	N/A
Winter wildlife survey (including birds)	February 18, 2015 Incidental observations One (1) visit	March 2 and 31, 2016 Incidental observations Two (2) visits
Spring diurnal migrating raptor	April 15, 2015 One (1) watch count station One (1) visit	N/A
Spring nocturnal owl	April 15, 2015 Four (4) call playback stations One (1) visit	April 11, 2016 Eight (8) call playback stations One (1) visit
Spring migration monitoring	April 21 - June 4, 2016 Twelve (12) point count stations Six (6) visits - weekly	May 12-27, 2016 Forty-five (45) point count stations Three (3) visits - weekly
Breeding bird	June 2015 Twenty-four (24) point count stations Two (2) visits - early and late	June 2016 Fifty (50) point count stations Two (2) visits - early and late
Common Nighthawk	June 2015 Three (3) call playback stations Two (2) visits	June 2016 Twelve (12) call playback stations Two (2) visits

Detailed descriptions of the survey methodologies for each of these baseline monitoring programs are provided in the following sections.

6.9.2.4 Fall Migration

Fall migration surveys were completed by MEL biologists in accordance with the methods outlined by the Canadian Wildlife Service (CWS) in the *Migratory Birds Environmental Assessment Guidelines* (Milko, 1998). Thirty-two point count stations were established through all representative habitat types within the mine footprint PA.

Four additional point count locations were established and surveyed during fall 2015 (Crusher Point count numbers 1-4, or CPC1-CPC4). At this time, the Project Footprint within the mine footprint PA consisted of two main areas: the pit and waste-rock stockpile were proposed in the current mine footprint PA, but the crusher was proposed to be in a separate area, approximately 4 km south of the mine footprint along the Beaver Dam Mines Road. Through further detailed design of the Project layout, the separate crusher area was incorporated into the current mine footprint PA. As such, the data collected in the crusher point count locations were not included in the analysis of fall 2015 migration data. Any priority species which were observed at these locations are included in the summary of priority species as incidental observations. Fall bird migration surveys were not conducted within the haul road PA because habitat types were generally similar to those observed within the mine footprint. Point count locations are presented on Figures 6.8-1 and 6.8-1A to 6.8-1L.

Surveys began at, or within, half an hour of sunrise and were completed within four-and-a-half hours or by 10:00 a.m., whichever came first. Weather conditions (e.g., precipitation and visibility) were monitored and confirmed to be within the parameters required by monitoring programs such as Environment and Climate Change Canada's Breeding Bird Survey. Ten-minute point counts were conducted weekly between September 17 and October 19, 2014, during peak migration. Bird observations were recorded at four distance categories, within a 50 m radius, 50 to 100 m radius, outside the 100 m radius, and flyovers. For each point count, a record was made of the start time and a hand held GPS unit was used to geo-reference its location. General observations, including the temperature, visibility, wind speed, date, start and end time, and location (UTM NAD83) were also recorded. Species recorded outside of the 100 m radius, between point counts, outside of the 10-minute survey window, and flyovers were recorded as incidentals. Bearings (in degrees) were taken for SOCI and SAR observed during dedicated survey periods and incidentally.

6.9.2.5 Winter birds

No dedicated surveys for winter birds took place within the PA; however, incidental observations of birds were recorded during winter wildlife (primarily moose) surveys.

6.9.2.6 Spring Diurnal Raptor Migration

The objectives of the baseline spring migrating raptor survey were to determine species composition and relative abundance and to record incidental observations of other SOCI and SAR. The survey was not conducted if visibility was reduced by rain, fog, or snow.

On April 15, 2015, two observers surveyed for migrating raptors at a fixed monitoring station within the mine footprint PA using the double-observer method (Nichols et al., 2000). Observers used binoculars and the naked-eye to scan for migrating raptors. A map of the PA, including the location of the monitoring station and a compass were used to document flight paths and estimate distances. The survey started at 12:30 p.m. and ended at 4:30 p.m. The spring raptor migration survey location is presented on Figures 6.8-1 and 6.8-1A to 6.8-1L.

Before a raptor was officially tallied, it had to demonstrate a migratory pattern as opposed to a behavior indicative of a local bird. Raptors are counted as migrants if they are: using thermals, flying a straight course northeast, or are at a very high altitude. Raptors are not counted as migrants if they are: in view for extended periods of time, actively hunting, or flying the "wrong way".

All birds considered migratory were tallied by date and hour using the *Hawk Monitoring Association of North America (HMANA) Daily Report Form* (HMANA, 1998). In addition to count totals of each species, observers recorded the following data hourly on the *HMANA Daily Report Form*: temperature, maximum visibility, sky conditions (cloud cover, precipitation), wind speed and direction, flight speed, direction and altitude, number of observers, and minutes of observation. Categories and codes for these data and brief instructions for gathering the data are available on the back of the *HMANA Daily Report Form*.

6.9.2.7 Spring Nocturnal Owl

The objectives of the nocturnal owl survey were to gather information on the presence and distribution of owl species within the mine footprint and haul road PA, determine the location of active nests, and record incidental observations of other SOCI and SAR.

Wind can limit the ability of owls to hear a call broadcast and/or the ability of the observer to hear an owl calling. It is recommended that a survey be suspended if wind speed is Beaufort 4 or higher (i.e., > 20 km/hr.; Takats et al., 2001). However, if there are other circumstances affecting detection, it may be necessary to reduce the wind threshold; this is at the discretion of the observer. If conditions were not suitable for surveying, then the survey was deferred or moved to a more suitable location.

Owls have been observed to be less vocal when temperatures are significantly lower than average for the season, thus surveys were also delayed in this circumstance (Takats et al., 2001). Surveys were stopped in the case of heavy precipitation; light drizzle and flurries are not likely to reduce calling rates or detectability (Takats et al., 2001).

The methods for monitoring nocturnal owls followed the *Guideline for Nocturnal Owl Monitoring in North America* (Takats et al., 2001). The nocturnal owl surveys took place on April 15, 2015 (mine footprint PA; n=4) and April 11, 2016 (haul road PA; n=8), once per year when vocal activity of the majority of owl species is greatest (Takats et al., 2001), for a total of 12 call playback stations throughout the PA. According to Greg Campbell (Senior Project Biologist with the Atlantic Chapter of Bird Studies Canada), in Nova Scotia, data collected through the *Nova Scotia Nocturnal Owl Survey* program shows peaks in barred (*Strix varia*) and great horned (*Bubo virginiatus*) owls in early April, while northern saw-whet owls (*Aegolius acadicus*) are late April to mid-May. Other owl species have been observed at numbers that are too low to determine peak calling periods (G. Campbell, pers. comm., 9 April, 2015).

Prior to starting the survey, the broadcaster being used (Pyle-Pro Pwma50db 50 watt portable waist band PA system) was tested to ensure that the owl calls being broadcasted from it were audible and recognizable at a distance of 400 m (Takats et al., 2001). Ensuring that the broadcast could be heard beyond 400 m minimizes bias at the next survey station due to owls hearing the recording from the previous station (Takats et al., 2001). The aforementioned test was carried out under weather and noise conditions similar to those that were likely to be encountered during the survey.

The broadcast used by the Bird Studies Canada Nova Scotia Nocturnal Owl Survey program was used for the survey. It consists of a 9.5 minute broadcast, which includes alternating owl calls with silent listening periods (BSC Atlantic Region, 2007). Only the calls of two owl species, the boreal (*Aegolius funereus*) and barred owls, are used in the BSC Nova Scotia Nocturnal Owl Survey program broadcast because they are particularly rare and sensitive, respectively. To date, the boreal owl has only been reported as breeding in Nova Scotia four times (Lauff, 2009). The barred owl is targeted because it has been used as an indicator of ecosystem health due to its dependence on cavities in large trees for nesting (Allen, 1987).

playback stations were spaced at least 1.6 km apart in order to reduce the chances of detecting the same owl at multiple stations (Takats et al., 2001). Some of the louder owls, such as the barred owl, can be heard at distances of two kilometers or more (Takats, 1998, as cited in Takats et al., 2001). However, most of the smaller owls cannot be heard as far or as clearly (Takats et al., 2001). Surveys were conducted between half an hour after sunset and midnight (Takats et al., 2001). There are five species of nocturnal owls that could potentially breed at the Project site: the great horned, barred, long-eared (*Strix varia*), boreal, and northern saw-whet owls. Nocturnal owl point count locations are presented on Figures 6.8-1 and 6.8-1A to 6.8-1L.

6.9.2.8 Spring Migration

Weekly spring migration surveys were conducted at 12 point count stations within the mine footprint PA by MEL biologists from April 21 to June 4, 2015 (six visits), and 45 point count stations within the haul road PA were completed May 12-27, 2016 (three visits), for a total of 57 point count stations within the PA. The scope of the spring migration survey within the mine footprint PA was reduced because poor weather conditions and a late spring melt restricted access within the PA that season.

The surveys were conducted using the same methodology as the fall migration survey. Early morning point count surveys were conducted from 30-minutes before sunrise until 10:00 a.m. Species and number of birds observed at each point count location were recorded. Point count stations are presented on Figures 6.8-1 and 6.8-1A to 6.8-1L.

6.9.2.9 Breeding Birds

Surveys for breeding birds were conducted in June 2015 at 24 point count stations within the mine footprint PA and at 50 point count stations within the haul road PA in June 2016. The breeding bird survey within the mine footprint PA was reduced to 24 point count stations (i.e., from 32 in the fall) because of minor modifications to the PA. Five additional point count stations were added for breeding bird surveys along the haul road (i.e., up from 45 in the fall) in order to cover additional area. Targeted surveys for common nighthawk were also conducted. The methodologies for these surveys are described in the following sections.

6.9.2.9.1 Point Counts

Two rounds of surveys for breeding birds were conducted by MEL biologists from June 8-11 (early) and June 25-26 (late), 2015, at 24 point count stations within the mine footprint PA. Two rounds of surveys for breeding birds were conducted by MEL from June 13-17 (early) and June 22-28 (late), 2016, at 50 point count stations within the haul road PA. The surveys were conducted using the same methods as the fall and spring migration surveys. Early morning point count surveys were conducted from 30-minutes before sunrise until 10:00 a.m. Species and number of birds observed at each point count location were recorded.

6.9.2.9.2 Common Nighthawk

The common nighthawk prefers to nest in gravelly substrates and is best detected while foraging for insects shortly after sunset. Suitable habitat is available for this species within the PA, therefore, dedicated surveys for the common nighthawk were conducted from mid- to end of June at either dawn (1 hour before sunrise to 30 minutes after sunrise) or dusk (30 minutes before sunset to an hour after sunset), as described in the Common Nighthawk Survey Protocol (Saskatchewan Ministry of Environment, 2015). Stations were spaced at least 800 m apart and a point count survey with call playback was used to detect the presence of common nighthawk within the PA. A three-minute passive point count was conducted at each station, followed by a call playback which includes 30-seconds of the conspecific common nighthawk call followed by 30-seconds of silence (or passive surveying), repeated for three-minutes (i.e., three times). The total time spent at each survey point was a minimum of six-minutes. Three call playback stations were surveyed within the mine footprint PA and 12 call playback stations were surveyed within the haul road PA, for a total of 15 call playback stations within the PA.

Common nighthawks require open ground or clearings for nesting. The species breeds in a wide range of open habitats, including sandy areas (e.g., dunes, eskers, and beaches), open forests (e.g., mixed wood and coniferous stands, burns, and clear cuts), grasslands (e.g., short-grass prairies, pastures, and grassy plains), wetlands (e.g., bogs, marshes, lakeshores, and riverbanks), gravelly or rocky areas (e.g., outcrops, barrens, gravel roads, gravel rooftops, railway beds, mines, quarries, and bare mountain tops and ridges), and some cultivated or landscaped areas (e.g., parks, military bases, airports, blueberry fields, orchards, cultivated fields) (New Hampshire Fish and Wildlife Department, 2015; Campbell et al., 2006; and COSEWIC, 2007).

Within both the mine footprint PA and the haul road PA, habitats surveyed for common nighthawk breeding activity were located at widened roadsides with expansive gravel areas and clear-cuts. Point count locations and common nighthawk survey points are presented on Figures 6.8-1 and 6.8-1A to 6.8-1L.

6.9.3 Baseline Conditions

Baseline assessments for birds were completed from September 2014 through June 2016 by MEL biologists. A total of 4,726 minutes (79 hours) of surveys were completed over five seasons. These surveys resulted in the observation of 6,193 individuals, representing 103 species within the PA. Within each seasonal survey, observations determined to be ‘incidental’ were not included in the analysis. These included individuals observed at a distance greater than 100 m, those which simply flew over the point count location, those observed outside of the 10-minute survey window, and those observed outside of a designated point count location.

During the fall 2014 surveys, individuals observed at any of the four crusher point count locations (CPC1-4) were determined to be incidental observations. Those point count locations are outside of the current mine footprint PA and are not relevant to the current design of the Project. As such, the proportion of incidentals in the fall 2014 survey is relatively higher than in other seasons. Priority species observed at these locations are still included in the priority species summaries (Section 6.10.3.7). Table 6.9-4 below identifies the total number of individuals and species observed in each season, the number carried forward to analysis in the upcoming sections (column titled ‘Included in Analysis’), and a list of species that were only observed incidentally.

Table 6.9-4. Summary of bird observations for each monitoring period

Season	Total # of Individuals	Total # of Species	Included in Analysis	Incidentals: Not Included in Analysis	Species Observed Only Incidentally
Fall 2014	832	47	414	418	American Black Duck, Canada Goose, Common Loon, Great Horned Owl, Pine Siskin, Purple Finch, Red Crossbill, Rusty Blackbird
Spring 2015	887	63	563	324	Common Raven, Wood Duck, Common Merganser, American Crow
Breeding 2015	422	52	330	92	Canada Goose, Northern Parula, Olive-sided Flycatcher
Spring 2016	2274	73	1707	567	American Crow, Barn Swallow, Common Goldeneye, Common Loon, Red Crossbill, Mourning Dove, Northern Waterthrush, Pine Siskin, Ring-necked Pheasant
Breeding 2016	1778	68	1545	233	Northern Harrier, Common Loon, Eastern Wood Pewee, Olive-sided Flycatcher.

Across all survey seasons, a total of 25 priority species were observed either during dedicated survey periods or incidentally:

- Common Nighthawk (*Chordeiles minor*)
- Chimney Swift (*Chaetura pelagica*)
- Wilson's Snipe (*Gallinago delicate*)
- Greater Yellowlegs (*Tringa melanoleuca*)
- Northern Harrier (*Circus cyaneus*)
- Northern Goshawk (*Accipiter gentilis*)
- Black-backed Woodpecker (Picoides arcticus)
- Peregrine Falcon (Falco peregrinus)
- Eastern Wood Pewee (Contopus virens)
- Olive-sided Flycatcher (Contopus cooperi)

- Yellow-bellied Flycatcher (Empidonax flaviventris)
- Gray Jay (Perisoreus canadensis)
- Barn Swallow (Hirundo rustica)
- Boreal Chickadee (Poecile hudsonicus)
- Red-breasted Nuthatch (Sitta canadensis)
- Ruby-crowned Kinglet (Regulus calendula)
- Swainson's Thrush (Catharus ustulatus)
- Gray Catbird (Dumetella carolinensis)
- Red Crossbill (Loxia curvirostra)
- Pine Siskin (Spinus pinus)
- Tennessee Warbler (Oreothlypis peregrine)
- Bay-breasted Warbler (Setophaga castanea)
- Blackpoll Warbler (Setophaga striata)
- Canada Warbler (Cardellina canadensis)
- Rusty Blackbird (Euphagus carolinus)

These species are discussed in detail in the SAR Section 6.10.

Bird species were identified based on functional bird groups to understand how each group of birds is using the PA. These functional groups include passerines (songbirds), non-passerine landbirds, raptors, shorebirds, and waterfowl. Table 6.9-5 presents all species observed during baseline assessments (excluding incidental observations), including seasonal and total abundance. The relative abundance of avian species is also provided in **Appendix M**.

Table 6.9-5 Seasonal and total abundances of avian species identified during the 2014 to 2016 baseline assessments for dedicated fall, spring, and breeding bird surveys

Common name	Scientific name	Fall (2014)	Spring (2015)	Breeding (2015)	Spring (2016)	Breeding (2016)	Total
Alder Flycatcher	*Empidonax alnorum*	0	5	7	1	39	52
American Black Duck	*Anas rubripes*	0	1	0	1	11	13
American Coot	*Fulica Americana*	0	0	0	1	0	1
American Crow	*Corvus brachyrhynchos*	3	0	0	0	5	8
American Goldfinch	*Spinus tristis*	0	6	1	21	50	78
American Kestrel	*Falco sparverius*	0	0	0	1	0	1
American Redstart	*Setophaga ruticilla*	0	6	17	46	13	82
American Robin	*Turdus migratorius*	3	22	3	23	25	76
Bald Eagle	*Haliaeetus leucocephalus*	0	0	0	0	0	0
Barn Swallow*	*Hirundo rustica*	0	0	0	0	0	0
Barred Owl	*Strix varia*	0	0	0	0	1	1
Bay-breasted Warbler*	*Setophaga castanea*	0	0	0	19	2	21
Belted Kingfisher	*Megaceryle alcyon*	4	1	0	0	5	10
Black-and-white Warbler	*Mniotilta varia*	0	19	22	111	60	212
Black-backed Woodpecker*	*Picoides arcticus*	0	0	0	3	2	5
Blackburnian Warbler	*Setophaga fusca*	0	0	0	4	13	17
Black-capped Chickadee	*Poecile atricapillus*	69	2	4	23	40	138
Blackbird sp.		0	5	0	0	0	5
Blackpoll Warbler*	*Setophaga striata*	11	0	0	2	11	24
Black-throated blue Warbler	*Setophaga caerulescens*	0	0	0	3	3	6
Black-throated Green Warbler	*Setophaga virens*	0	18	20	153	80	271
Blue Jay	*Cyanocitta cristata*	7	0	1	8	8	24
Blue-headed Vireo	*Vireo solitarius*	6	6	1	79	41	133
Boreal Chickadee*	*Poecile hudsonicus*	9	4	0	2	0	15

Table 6.9-5 Seasonal and total abundances of avian species identified during the 2014 to 2016 baseline assessments for dedicated fall, spring, and breeding bird surveys

Common name	Scientific name	Fall (2014)	Spring (2015)	Breeding (2015)	Spring (2016)	Breeding (2016)	Total
Brown Creeper	*Certhia Americana*	0	0	0	3	7	10
Brown-Headed Cowbird	*Molothrus ater*	0	1	0	0	0	1
Canada Goose	*Branta canadensis*	0	0	0	2	0	2
Canada Warbler*	*Cardellina canadensis*	0	0	2	10	4	16
Cedar Waxwing	*Bombycilla cedrorum*	5	0	2	0	10	17
Chestnut-sided Warbler	*Setophaga pensylvanica*	0	1	0	0	12	13
Chipping Sparrow	*Spizella passerina*	0	1	1	0	6	8
Common Goldeneye	*Bucephala clangula*	0	0	0	0	0	0
Common Grackle	*Quiscalus quiscula*	7	110	15	12	2	146
Common loon	*Gavia immer*	0	1	1	0	0	2
Common Nighthawk*	*Chordeiles minor*	0	0	0	0	1	1
Common Raven	*Corvus corax*	8	0	0	3	2	13
Common Yellowthroat	*Geothlypis trichas*	4	25	31	93	141	294
Dark-eyed Junco	*Junco hyemalis*	21	38	8	62	104	233
Downy Woodpecker	*Picoides pubescens*	1	1	0	0	2	4
Duck sp.	.	0	2	0	0	0	2
Eastern Phoebe	*Sayornis phoebe*	0	0	2	0	0	2
European Starling	*Sturnus vulgaris*	0	0	0	0	4	4
Evening Grosbeak	*Coccothraustes vespertinus*	0	0	0	2	0	2
Golden-crowned Kinglet	*Regulus satrapa*	68	14	2	63	53	200
Gray Catbird*	*Dumetella carolinensis*	0	0	0	0	1	1
Gray Jay*	*Perisoreus canadensis*	28	0	1	11	0	40
Great horned Owl	*Bubo virginianus*	0	0	0	1	0	1

Table 6.9-5 Seasonal and total abundances of avian species identified during the 2014 to 2016 baseline assessments for dedicated fall, spring, and breeding bird surveys

Common name	Scientific name	Fall (2014)	Spring (2015)	Breeding (2015)	Spring (2016)	Breeding (2016)	Total
Greater yellowlegs*	*Tringa melanoleuca*	0	13	2	3	5	23
Hairy Woodpecker	*Picoides villosus*	3	1	0	6	3	13
Hermit Thrush	*Catharus guttatus*	6	11	4	62	99	182
Hooded Merganser	*Lophodytes cucullatus*	0	2	1	0	0	3
Least Flycatcher	*Empidonax minimus*	0	17	14	9	13	53
Lincoln's Sparrow	*Melospiza lincolnii*	0	4	1	21	4	30
Magnolia Warbler	*Setophaga magnolia*	0	46	34	167	95	342
Mallard	*Anas platyrhynchos*	6	0	0	0	0	6
Mourning Dove	*Zenaida macroura*	1	0	0	0	3	4
Mourning Warbler	*Geothlypis philadelphia*	0	0	0	0	5	5
Nashville Warbler	*Oreothlypis ruficapilla*	0	3	8	12	0	23
Northern Flicker	*Colaptes auratus*	8	9	4	11	8	40
Northern Goshawk*	*Accipiter gentilis*	0	0	0	1	0	1
Northern harrier*	*Circus cyaneus*	0	0	1	0	0	1
Northern Parula	*Setophaga americana*	0	1	0	8	27	36
Northern Waterthrush	*Parkesia noveboracensis*	0	1	2	9	2	14
Olive-sided Flycatcher*	*Contopus cooperi*	0	0	0	0	2	2
Ovenbird	*Seiurus aurocapilla*	0	0	1	33	29	63
Palm Warbler	*Setophaga palmarum*	18	17	22	134	52	243
Peregrine Falcon*	*Falco peregrinus*	1	0	0	0	0	1
Pileated Woodpecker	*Dryocopus pileatus*	3	3	0	6	1	13
Pine Siskin*	*Spinus pinus*	0	0	0	0	0	0
Purple Finch	*Haemorhous purpureus*	0	0	0	11	4	15
Red crossbill*	*Loxia curvirostra*	0	0	0	0	0	0

Table 6.9-5 Seasonal and total abundances of avian species identified during the 2014 to 2016 baseline assessments for dedicated fall, spring, and breeding bird surveys

Common name	Scientific name	Fall (2014)	Spring (2015)	Breeding (2015)	Spring (2016)	Breeding (2016)	Total
Red-breasted Nuthatch*	*Sitta canadensis*	1	1	0	6	14	22
Red-eyed Vireo	*Vireo olivaceus*	0	5	9	0	40	54
Red-tailed Hawk	*Buteo jamaicensis*	3	0	0	0	2	5
Red-winged Blackbird	*Agelaius phoeniceus*	0	8	0	0	0	8
Ring-necked Duck	*Aythya collaris*	2	3	0	0	0	5
Ring-necked pheasant	*Phasianuas colchicus*	0	0	0	0	0	0
Ruby-crowned Kinglet*	*Regulus calendula*	5	23	8	70	71	177
Ruffed Grouse	*Bonasa umbellus*	7	9	5	19	2	42
Savannah Sparrow	*Passerculus sandwichensis*	0	0	1	2	0	3
Sharp-shinned Hawk	*Accipiter striatus*	0	0	0	1	0	1
Shorebird spp.			2				2
Song Sparrow	*Melospiza melodia*	4	5	3	2	1	15
Spotted sandpiper	*Actitis macularius*	0	2	0	0	0	2
Spruce Grouse	*Falcipennis canadensis*	6	4	1	7	0	18
Swainson’s Thrush*	*Catharus ustulatus*	0	3	10	32	16	61
Swamp Sparrow	*Melospiza georgiana*	8	2	5	33	11	59
Tennessee Warbler*	*Oreothlypis peregrina*	0	0	1	0	0	1
Tree Swallow	*Tachycineta bicolor*	0	19	8	15	2	44
Warbler sp.	.	0	0	0	0	0	0
White-throated Sparrow	*Zonotrichia albicollis*	12	29	18	66	133	258
White-winged crossbill	*Loxia leucoptera*	0	0	0	13	1	14
Wilson's snipe*	*Gallinago delicata*	0	3	1	1	0	5
Winter Wren	*Troglodytes hiemalis*	0	2	2	23	15	42

Table 6.9-5 Seasonal and total abundances of avian species identified during the 2014 to 2016 baseline assessments for dedicated fall, spring, and breeding bird surveys

Common name	Scientific name	Fall (2014)	Spring (2015)	Breeding (2015)	Spring (2016)	Breeding (2016)	Total
Wood Duck	*Aix sponsa*	1	0	0	1	0	2
Woodpecker sp.	.	2	5	0	5	6	18
Yellow Warbler	*Setophaga petechia*	6	1	3	1	33	44
Yellow-bellied Flycatcher*	*Empidonax flaviventris*	0	1	8	14	37	60
Yellow-bellied Sapsucker	*Sphyrapicus varius*	0	1	0	0	2	3
Yellow-rumped Warbler	*Setophaga coronata*	57	18	12	140	49	276
Total	**100 species****	**414**	**563**	**330**	**1707**	**1545**	**4559**

Notes: *Species numbers in the table are only for those observed within the 100 m point count radius and within the dedicated point count periods. Birds observed during owl, common nighthawk, diurnal migrating raptor, and winter wildlife surveys are not included, but discussed below.*

6.9.3.1 Winter Birds

Seven confirmed species and two unidentified species (i.e., a woodpecker and a sparrow) were observed incidentally during winter wildlife surveys along the haul road PA: black-capped chickadee (*Poecile atricapillus*), ruffed grouse (*Bonasa umbellus*), dark-eyed junco (*Junco hyemalis*), cedar waxwing (*Bombycilla cedrorum*), black duck (*Anas rubripes*), common grackle (*Quiscalus quiscula*), and golden-crowned kinglet (*Regulus satrapa*). Five species were observed within the mine footprint PA during winter wildlife surveys: black-capped chickadee, cedar waxwing, northern saw-whet owl (*Aegolius acadicus*), downy woodpecker (*Picoides pubescens*), and American crow (*Corvus brachyrhynchos*). No priority overwintering bird species were observed.

6.9.3.2 Spring Diurnal Raptor Migration

Three raptors were observed during the dedicated spring migrating raptor survey that took place on April 15, 2015 within the mine footprint PA. The first raptor was a migrating adult bald eagle (*Haliaeetus leucocephalus*), which was observed flying southeast at high altitude, though it could still be identified easily with the unaided eye. The other two raptors, which were determined to be local non-migrating birds due to their behaviours (actively hunting and in view for extended periods of time), were an adult male northern harrier (*Circus cyaneus*) and an adult female American kestrel (*Falco sparverius*). None of the species observed were priority species. The northern harrier is considered a priority species when observed during breeding season surveys (S-Rank is S3S4B). A targeted survey for spring diurnal raptor migration was not conducted within the haul road PA. Targeted surveys within the mine footprint PA completed in 2015 suggest that the broader Project Area does not fall within a major migration route for spring migrating raptors, and thus targeted surveys for raptors were not necessary within the haul road PA in 2016.

6.9.3.3 Nocturnal Owl

No owls were observed during the dedicated nocturnal owl call playback surveys within the mine footprint or along the haul road. However, owls were observed in the PA (see Table 6.9 5) during other avian surveys, including the great horned owl (*Bubo virginianus*), northern saw-whet owl (*Aegolius acadicus*), and barred owl (*Strix varia*).

6.9.3.4 Fall Migration

The fall bird migration survey consisted of 32 point count stations and dedicated surveys were conducted weekly from September 17th to October 19th, 2014, for a total of four visits within the mine footprint PA. During fall migration, 832 individuals representing 47 species were observed. Incidental observations were removed (including all individuals identified in the CPC1-2 point counts), resulting in 414 individuals of 39 species. See Figures 6.10-1 and 6-10-1A to 6.10-1L for relative species abundance. An additional eight species were observed incidentally, listed in Table 6.9-5. In total, six priority species were observed during fall migration surveys.

The most commonly observed species were black-capped chickadee (*Poecile atricapillus*; n=69), followed by golden-crowned kinglet (*Regulus satrapa*; n=68), and yellow-rumped warbler (*Setophaga coronata*; n=57). Most observations documented groups of up to two individuals, though there were a few groups ranging between three and six individuals. Two observations of obvious migrants were documented on September 30, 2014. On this date, one flock of 50 pine siskins and another flock of 25 were observed at PC24 and PC26, respectively. These observations are the only obvious migrants noted based on their abundance. These observations are recorded as incidentals and not included in the analysis provided herein because they were identified as flyovers. The most abundant group observed on site during the fall migration period was passerines (songbirds), which accounted for 62.2% of species and 88.4% of individuals. Non-passerine land birds were the next most abundant group on-site, followed by waterfowl.

Fall bird migration surveys were not conducted within the haul road PA because habitat types identified within this section of the PA were generally similar to those observed within the mine footprint PA. Overall Project interactions with migrating birds are expected to be low along the haul road footprint due to the linear nature of the haul road and its proposed upgrade to support mine development and trucking of ore from Beaver Dam to Touquoy for processing. There are no known significant migratory flyways, nor were there any observed during surveys along the haul road or the mine footprint PA. Wetlands, often habitat considered important for birds, are also consistent in type and habitat characteristics along the haul road and within the mine footprint.

6.9.3.5 Spring Migration

Due to poor weather conditions (delayed spring thaw and melt), significant snow cover, and access challenges, the 2015 spring bird migration survey had a reduced scope of 12 point count stations within the mine footprint PA. Spring bird migration surveys were conducted weekly from April 21st to May 24th, 2015, for a total of five visits. During spring migration, 887 individuals, representing 63 species were observed. Incidental observations were removed as described earlier. A total of 563 individuals, representing 56 species, were carried forward for analysis. Four priority species were observed during spring migration surveys within the mine footprint PA.

During spring migration surveys completed in 2015 within the mine footprint PA, common grackle was the most commonly observed species (*Quiscalus quiscula,* n= 110), followed by magnolia warbler (*Setophaga magnolia,* n=46), Dark-eyed Junco (*Junco hyemalis*, n=38), and white-throated sparrow (*Zonotricha albicollis*, n= 29). The most abundant and diverse group of birds observed during spring surveys in the mine footprint PA was passerines, which accounted for 88.8% of individuals, followed by non-passerine land birds (5.86%), and shorebirds (3.55%).

Within the haul road PA, 45 point count stations were surveyed during the spring bird migration period. Spring bird migration surveys were conducted from May 12 to 27, 2016, for a total of three visits. During spring migration, 2,274 individuals representing 73 species were observed. Once incidental observations were removed, 1,773 individuals, representing 63 species, were carried forward into the analysis. Nine priority species were observed during spring migration surveys completed within the haul road PA. Priority species observed during spring migration monitoring is discussed in Section 6.10.

The species most commonly observed was magnolia warbler (*Setophaga magnolia*; n=167), followed by black-throated green warbler (*Setophaga virens;* n= 153), and yellow-rumped warbler (*Setophaga coronata*; n=140). No obvious concentration of ducks or shorebirds was observed. The most abundant and diverse group of birds observed in spring migration surveys within the haul road

PA is passerines, which accounted for 95.9% of individuals, followed by non-passerine land birds (3.34%).

The majority of observations were of single individuals and the largest groups of birds observed were two flocks of common grackle in 2015. One flock contained 50 individuals and was observed on June 4th and the second flock contained 30 individuals and was observed on May 1st, both in 2015 within the mine footprint PA. No obvious migrants were documented within the haul road PA. See Figures 6.10-1 and 6-10-1A to 6.10-1L for the abundances of species observed during spring migration surveys completed in 2015 and 2016 within the mine footprint PA and the haul road PA.

6.9.3.6 Breeding Season

The 2015 breeding bird survey consisted of 24 point count stations, which were surveyed twice in the month of June 2015 within the mine footprint PA. A total of 442 species representing 52 species were recorded during breeding season in the mine footprint PA. Once incidentals were removed, as described earlier, 330 individuals of 47 species were carried forward for analysis. Thirteen priority species were observed during the breeding season surveys completed within the mine footprint PA, which are discussed in detail in Section 6.10.3.7.

The most abundant species observed was the magnolia warbler (*Setophaga magnolia*, n=34), followed by the common yellowthroat (*Geothylpis trichas,* n=31), the black-and-white warbler (*Mniotilta varia*, n = 22), and the palm warbler (*Setophaga palmarum*, n=22). Passerines represented the most abundant and diverse group of birds observed, accounting for 95.2% of all individuals, followed by non-passerine land birds (3.0% of individuals). In June 2016, 50 point count stations were surveyed within the haul road PA. A total of 1,178 individuals representing 68 species were observed during the breeding season within the haul road PA. When incidental observations were removed, a total of 1,707 individuals representing 65 species were carried forward for analysis. Fourteen priority species were observed during breeding season surveys within the haul road PA, which are discussed in detail in Section 6.10.3.7.

The most commonly observed species in the breeding season of 2016 was the common yellowthroat (*Geothylpis trichas,* n=141), followed by the white-throated sparrow (*Zonotricha albicollis*, n=133), and the dark-eyed junco (*Junco hyemalis,* n=104). Similar to results obtained in the breeding season in 2015, passerines represented the greatest abundance and diversity of all bird groups in the breeding season of 2016. Passerines accounted for 96.5% of individuals, followed by non-passerine land birds, which accounted for 1.9% of individuals.

Breeding evidence was recorded for all species observed during 2015 and 2016 breeding season surveys, in accordance with guidance provided by the Maritime Breeding Bird Atlas (see breeding codes, **Appendix L**). Since the site surveyed is a relatively small part of the surrounding area, it is not possible to confirm that all species listed were actually nesting within the boundaries of the PA. For instance, if a bird was observed carrying food (i.e., example of confirmed breeding evidence, based on MBBA, Bird Studies Canada, n.d.), it is possible that the bird was nesting on an adjacent parcel of land. A summary table is presented below, which identifies the highest breeding evidence recorded for each species in surveys completed in 2015 and 2016 in the mine footprint PA and haul road PA, respectively. Breeding evidence codes were determined for all species observed during each annual survey, including those observed incidentally during bird surveys.

Table 6.9-6 Breeding Summary within the Beaver Dam Mine PA

Code	Common Name	2015 Breeding Evidence	2016 Breeding Evidence
ABDU	American Black Duck	.	Confirmed
ALFL	Alder Flycatcher	Probable	Probable
AMCR	American Crow	.	Possible
AMGO	American Goldfinch	Possible	Probable
AMRE	American Redstart	Probable	Probable
AMRO	American Robin	Probable	Probable
BADO	Barred Owl	.	Possible
BAWW	Black-and-white Warbler	Probable	Probable
BBWA	Bay-breasted Warbler	.	Possible
BBWO	Black-backed Woodpecker	.	Possible
BCCH	Black-capped Chickadee	Possible	Probable
BEKI	Belted Kingfisher	.	Possible
BHVI	Blue-headed Vireo	Possible	Probable
BLBW	Blackburnian Warbler	.	Possible
BLJA	Blue Jay	Possible	Possible
BPWA	Blackpoll Warbler	.	Possible
BRCR	Brown Creeper	.	Possible
BTBW	Black-throated Blue Warbler	.	Possible
BTNW	Black-throated Green Warbler	Probable	Probable
CAGO	Canada goose	Confirmed	.
CAWA	Canada Warbler	Probable	Probable
CEDW	Cedar Waxwing	Possible	Possible
CHSP	Chipping Sparrow	Possible	Possible
COGR	Common Grackle	Probable	Probable
COLO	Common Loon	Possible	Possible
CONI	Common Nighthawk	.	Possible
CORA	Common Raven	.	Possible
COYE	Common Yellowthroat	Probable	Probable
CSWA	Chestnut-sided Warbler	.	Possible
DEJU	Dark-eyed Junco	Possible	Probable
DOWO	Downy Woodpecker	.	Possible
EAPH	Eastern phoebe	Possible	.
EUST	European Starling	.	Possible
GCKI	Golden-crowned Kinglet	Possible	Probable

Table 6.9-6 Breeding Summary within the Beaver Dam Mine PA

Code	Common Name	2015 Breeding Evidence	2016 Breeding Evidence
GRCA	Gray Catbird	.	Possible
GRJA	Gray jay	Possible	.
GRYE	Greater Yellowlegs	Probable	Probable
HAWO	Hairy Woodpecker	.	Possible
HETH	Hermit Thrush	Possible	Probable
HOME	Hooded merganser	Possible	.
LEFL	Least Flycatcher	Probable	Possible
LISP	Lincoln's Sparrow	Possible	Possible
MAWA	Magnolia Warbler	Probable	Probable
MODO	Mourning Dove	.	Possible
MOWA	Mourning Warbler	.	Possible
NAWA	Nashville warbler	Probable	.
NOFL	Northern Flicker	Probable	Probable
NOHA	Northern Harrier	Possible	Possible
NOPA	Northern Parula	Possible	Probable
NOWA	Northern Waterthrush	Possible	Possible
OSFL	Olive-sided Flycatcher	Possible	Possible
OVEN	Ovenbird	Possible	Probable
PAWA	Palm Warbler	Probable	Probable
PIWO	Pileated Woodpecker	.	Possible
PUFI	Purple Finch	.	Possible
RBNU	Red-breasted Nuthatch	.	Probable
RCKI	Ruby-crowned Kinglet	Probable	Probable
REVI	Red-eyed Vireo	Probable	Probable
RTHA	Red-tailed Hawk	.	Probable
RUGR	Ruffed Grouse	Probable	Confirmed
SAVS	Savannah sparrow	Possible	.
SOSP	Song Sparrow	Probable	Possible
SPGR	Spruce grouse	Probable	.
SWSP	Swamp Sparrow	Probable	Possible
SWTH	Swainson's Thrush	Confirmed	Probable
TEWA	Tennessee warbler	Possible	.
TRES	Tree Swallow	Probable	Possible
UNBB	Blackbird spp.	Possible	.
UNWO	Woodpecker sp.	Possible	Probable
WISN	Wilson's snipe	Possible	.

Table 6.9-6 Breeding Summary within the Beaver Dam Mine PA

Code	Common Name	2015 Breeding Evidence	2016 Breeding Evidence
WIWR	Winter Wren	Possible	Probable
WTSP	White-throated Sparrow	Probable	Confirmed
WWCR	White-winged Crossbill	.	Possible
YBFL	Yellow-bellied Flycatcher	Probable	Probable
YBSS	Yellow-bellied Sapsucker	.	Confirmed
YEWA	Yellow Warbler	Probable	Possible
YRWA	Yellow-rumped Warbler	Probable	Probable

All of the species identified are native species expected to be found in this area of Nova Scotia and the province in general, and within the typical and common habitat associated with the Project and surrounding landscape. The majority of observations were of a single individual. The largest flock of birds observed was common grackle (n=10). The most abundant group observed on site during the breeding bird period was passerines (songbirds), non-passerine land birds were the next most abundant group on-site, followed by waterfowl, shorebirds, and raptors, which were all observed in small numbers. See Figures 6.10-1 and 6-10-1A to 6.10-1L for the abundance of species observed during the breeding season. No incidental observations of raptor nests were made on either the mine or haul road footprints.

Results of spring and fall migration and breeding bird surveys are shown on Figures 6.10-1 and 6-10-1A to 6.10-1L and are provided in **Appendix M**.

6.9.3.7 Common Nighthawk

Four common nighthawks were observed within the haul road PA. One observation was recorded during a breeding bird survey at haul road PC26, while three were observed during dedicated call playback surveys along the haul road. None were observed within the mine footprint PA. Common nighthawks were observed calling, but no evidence of breeding behavior was documented (i.e., booming, or displaying females). Common nighthawks were observed within the haul road PA, in habitats with expansive gravelly areas adjacent to clear cuts, or disturbed areas (haul road PC26, CONI1, CONI9). Suitable habitat is present within the PA for this species, so their presence during the breeding season indicates that breeding is likely to be occurring within the PA.

6.9.3.8 Discussion

Of the 100 avian species observed during dedicated surveys (i.e., fall migration, spring migration, and breeding, excluding incidentals) within the PA, 77 (75% of species) are protected under the *Migratory Bird Convention Act* (1994). Ninety-eight percent (98%) of all individual birds observed during dedicated surveys (i.e., fall migration, spring migration, and breeding) are migratory birds. Birds observed that are not protected under the *Migratory Bird Convention Act* (1994) were from the Accipitridae (e.g., harriers and hawks), Alcedinidae (e.g., kingfisher), Corvidae (e.g., jays, crows and ravens), Phasianidae (e.g., grouse and pheasants), and Strigidae (e.g., owls) families.

Avian diversity was relatively higher along the haul road PA than within the mine footprint PA. This is likely attributable to the fact that the mine footprint PA is more extensively disturbed and fragmented as a result of historic mine operations and current and historic timber harvesting practices. Overall, avian diversity and abundance was moderate and fell within expectations for the habitats available and for forests in Halifax County in general.

Passerines were the dominant species group across all seasons within the PA, which is expected based on the variety of suitable habitats present within the PA. The order Passeriformes includes more than half of all bird species, so their relative abundance within the PA falls within expectation. Furthermore, the Passerine family contains the highest diversity of species. The landscape across the PA is dominated by forest cover (both deciduous and coniferous of different maturity levels) with harvested areas at different stages of regeneration and wetlands interspersed throughout.

Non-passerine land birds were the second most abundant species group observed within the PA and consisted primarily of grouse and woodpecker species. Habitats for these species are present throughout the PA. Woodpecker habitat preferences differ depending on the species; therefore, the variety of species observed (n=6) is an indicator of habitat types and diversity within the PA. For example, northern flickers (*Colaptes auratus*) are ground feeders and favour woodland edges near open areas, downy woodpeckers (*Picoides pubescens*) favour riparian woodlands, and pileated woodpeckers (*Dryocopus pileatus*) prefer mature hardwood and coniferous forests. Two species of grouse, the ruffed (*Bonasa umbellus*) and spruce grouse (*Falcipennis canadensis*), were observed within the PA. The ruffed grouse is considered to be dependent on subclimax deciduous forests, whereas the spruce grouse is considered dependent on climax coniferous forests (Pietz and Tester, 1982).

No large congregations of waterfowl or shorebirds were observed roosting or staging within the PA during either the spring or fall migration periods. Wetland habitats suitable for migrating shorebirds and waterfowl were limited within the PA (open water wetlands with shallow areas for foraging). The only shorebird that was likely breeding within the PA was the greater yellowlegs; this species breeds in muskeg, wet bogs with small wooded islands, and forests with abundant clearings (Elphick and Tibbits, 1998). The only waterfowl species observed during the breeding season within the PA was the American black duck (*Anas rubripes*) and its habitat preferences during the breeding season are influenced by wetland fertility, cover, and invertebrate densities (Merendino and Ankney, 1994). In Nova Scotia, American black ducks commonly nest along streams and contiguous freshwater marshes (Seymour, 1984), as well as coastal salt marsh (Reed and Moisan, 1971).

Raptors, both diurnal and nocturnal, were observed in low numbers within the PA throughout the year. Throughout the migration period, this suggests that there are no major migration corridors over the PA. As for the breeding season, suitable breeding habitat is present for several forest raptors, including northern goshawk, Cooper's hawk, sharp-shinned hawk, red-tailed hawk, merlin, American kestrel, great horned owl, barred owl, and northern saw-whet owl. Many of these forest raptor species are difficult to census; therefore, it is not surprising that documented species richness and abundance were low within the PA.

6.9.4 Consideration of Consultation and Engagement Results

Key issues raised during public consultation and Mi'kmaq engagement relating to birds include potential for direct mortality associated with the hauling operation and indirect effects on other VCs, such as dust, noise and light, as well as potential effects on birds associated with permanent loss of habitat from construction of the Beaver Dam Mine and the haul road. Potential effects on traditional uses of land and resources by the Mi'kmaq were noted, including fowling.

The results of the public consultation and Mi'kmaq engagement have been considered in the environmental effects assessment, including the Proponent's commitments on mitigation and monitoring measures and proposed compliance and effects monitoring programs, as well as the Proponent's broader commitment to ongoing public consultation and Mi'kmaq engagement. Specific to evaluating the effect on birds, these are found within the following environmental effects assessment.

6.9.5 Effects Assessment Methodology

6.9.5.1 Boundaries

Spatial Boundaries

The spatial boundaries used for the assessment of effects to birds are the mine footprint, haul road PA, and the LAA which consists of any habitat contiguous and consistent with habitat available within the PA. These spatial boundaries will help to identify the direct or indirect impacts to bird species and the effects of the Project on distribution and abundance of these species.

Temporal Boundaries

The temporal boundaries used for the assessment of effects to birds are the construction phase, operational phase, and decommissioning and reclamation phases.

Technical Boundaries

No technical boundaries were identified for the effects assessment of Birds.

Administrative Boundaries

Administrative boundaries for evaluation and management of birds include the *Nova Scotia Wildlife Act*, which protects all birds within the province and the *Migratory Birds Convention Act (MBCA)* which offers protection for migratory birds. Further protection is offered to SAR through the provincial *Nova Scotia Endangered Species Act* and the federal SARA.Thresholds for Determination of Significance

A significant adverse effect from the Project on birds is defined as an effect that is likely to cause a permanent alteration to any bird species distribution or abundance. An adverse effect that does not cause a permanent alteration in distribution or abundance of any bird species is considered to be not significant.

6.9.6 Project Activities and Birds Interactions and Effects

The assessment of potential adverse interactions and effects of the Project on this VC takes into account the potential for the Project to result in changes to:

- Permanent and temporary habitat alteration and fragmentation
- Disturbance and/or displacement
- Potential for direct and indirect mortality to individuals
- Attraction and disorientation resulting from night-lighting

Table 6.9-7 to Table 6.9-9 present the potential interactions of the Project with birds and bird habitat.

Table 6.9-7 Potential Bird Interactions with Project Activities at Beaver Dam Mine Site

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Clearing, grubbing, and grading in preparation of construction • Rock blasting in preparation of construction • Lighting of construction areas • Till and waste rock from site preparation transport and storage • Existing settling pond dewatering in preparation of construction • Watercourse and wetland alteration in preparation of construction • Mine site road construction • Surface infrastructure installation and construction • Collection and settling pond construction • General management of wastes derived from preparation and construction activities • Accidents and malfunctions to include fuel and other spills, forest fires, settling pond overflow, slope failure, and an unplanned explosive event
Operation and Maintenance	3-4 years	• Rock blasting to access and extract ore • Surface mine dewatering to facilitate access to and extraction of ore • Management of waste rock produced from crushing and preparing ore for transport • Treatment of site surface water runoff and surface mine pumped water • Site maintenance and repairs • General management of wastes derived from operation and maintenance activities • Lighting of facilities and roads • Accidents and malfunctions to include fuel and other spills, forest fires, settling pond overflow, slope failure, and an unplanned explosive event

Table 6.9-7 Potential Bird Interactions with Project Activities at Beaver Dam Mine Site

Project Phase	Duration	Relevant Project Activity
Decommissioning and Reclamation	1-2 years	• Infrastructure demolition • Site reclamation activities • General management of wastes derived from decommissioning and reclamation activities • Accidents and malfunctions to include fuel and other spills, and forest fires

Table 6.9-8 Potential Bird Interactions with Project Activities along Haul Road

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Clearing, grubbing, and grading in preparation of construction • Rock blasting in preparation of construction • Lighting of construction areas • Till and waste rock from site preparation transport and storage • Watercourse and wetland alteration in preparation of construction • Haul road construction and upgrades • General management of wastes derived from preparation and construction activities • Accidents and malfunctions to include fuel and other spills, and forest fires
Operation and Maintenance	3-4 years	• Haul road maintenance and repairs • Lighting of roads • Accidents and malfunctions to include fuel and other spills, and forest fires
Decommissioning and Reclamation	1-2 years	N/A[1]

1 Decommissioning and Reclamation of the haul road is not expected. The haul road will be returned to owner for forestry industry

Table 6.9-9 Potential Bird Interactions with Project Activities at Touquoy Processing and Tailings Management Facility

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Accidents and malfunctions to include fuel and other spills and forest fires
Operation and Maintenance	3-4 years	• Management of tailings produced from processing ore • Lighting of facilities and mine site roads • Environmental monitoring • General management of waste derived from processing activities • Accidents and malfunctions to include fuel and other spills and forest fires
Decommissioning and Reclamation	1-2 years	• Environmental monitoring • Accidents and malfunctions to include fuel and other spills and forest fires

Development of the mine infrastructure and upgrades to the haul road will cause direct impacts to habitat used by avifauna, including upland forested habitat and wetlands. This will occur mostly within the construction phase of the Project. Habitat within the PA and surrounding landscape currently exhibits fragmented conditions based on historic mine operations, existing road and trail networks, and current and historic timber harvesting activity within and adjacent to the PA. Project activities are likely to result in increased habitat fragmentation and a decrease in habitat quality for those species which rely especially on interior forest conditions, where intact interior forest remains. This decrease in habitat quality for species relying on interior forest condition is based on increased activity and sensory disturbance, along with increased physical fragmentation. Increase in physical fragmentation is expected to be low, based on the current high level of disturbed habitat as discussed.

Sensory disturbance to avifauna would result from rock blasting, clearing and grubbing, infrastructure construction, and overall increased traffic along the upgraded and new haul route during operations. These project components will likely result in the localized avifauna avoidance of the PA. Overall, project activities will likely cause a change in usage of the PA by avifauna, with some species tending to avoid the area, while others may be attracted to the increased activity. Sensory disturbance related to Project activity will occur within the mine footprint PA, haul road PA, and within the Touquoy Processing Facility, as the addition of material from the Beaver Dam mine will extend the life of the Touquoy Processing Facility by four years.

Changes to ambient noise levels and the presence of periodic vibrations from blasting have the potential to adversely affect fauna and birds by influencing migration and behavioral patterns. Noise and vibration is provincially regulated via the Workplace Health and Safety Regulations and the Pit and Quarry Guidelines, which protect the health of site workers and the general public at PA boundaries, respectively.

Direct mortality of avifauna species could result from Project activities, particularly due to the increase in traffic during construction and operation of the facility. Increased traffic poses a risk to avifauna along the length of the Haul Road between the Beaver Dam mine footprint and the Touquoy processing facility. Indirect mortality could result from exposure to contaminants or spills from incidents and accidents.

Migratory birds may be indirectly impacted as a result of the surface water quality in the shallow lake created in the Touquoy open pit mine, if they were to land in the water. However, as discussed in Section 6.3.6, water quality in the shallow lake is not anticipated to be affected by the deposition of Beaver Dam tailings. The majority of the cyanide reagent introduced to the tailings during ore processing will be degraded and hydrolyzed to carbon dioxide and ammonium during storage in the tailings pond. Similarly, this will be expected to occur for the Beaver Dam tailings being stored in the Touquoy open pit. Detoxification of the effluent will also result in levels of copper and cyanide that are below the MMER limits (Ausenco 2015). Mitigation measures will be applied to reduce the potential environmental impacts of the Project on migratory birds at the Touquoy facility as per existing approvals.

Table 6.9-10 Direct and Indirect Impacts of the Project on Birds

Impact Type	Direct Impact	Project Phase1	Indirect Impact	Project Phase1
Habitat alteration and fragmentation	Clearing and grubbing of open pit, rock storage, and new road construction areas may cause temporary and medium-term loss of habitat for birds.	C	Habitat fragmentation may alter habitat suitability for those species which rely on interior forest condition. Within the haul road PA, this change in habitat is expected to be permanent.	C
	Widening of existing road may cause a permanent loss of habitat for birds.			
	Construction of new roads may affect habitat use by birds (i.e., edge effect; Ortega and Capen, 2002).			
Disturbance or displacement	Clearing and grubbing of open pit, rock storage, and new road construction areas may cause disturbance or displacement of species.	C, O	Heavy machinery operation during open pit development, road construction, and construction of mine infrastructure for crushing and haul-out will increase dust emissions, which may affect surrounding vegetation and, consequently, birds (Farmer, 1993).	C, O, D
	Lights will be installed in active construction areas and on site facilities, including roads. This may cause disturbance or displacement of species, while attracting other species, or general behavioral changes (DaSilva, Valcu and Kempenaers, 2015).		For those species which may be attracted to lights (e.g., insectivores), lights may increase potential for direct mortally of these species or may increase habitat suitability by supplementing their source of prey.	
	Use of diesel-powered generators will cause noise that may disturb or displace birds from preferred habitats.		Vehicle activity for transportation of personnel and operating supplies will increase dust emissions, which may affect surrounding vegetation and, consequently, birds (Farmer, 1993).	
	Increased truck (i.e., 23-31 trucks/day and 12-16 hrs./day) and vehicular traffic will increase noise levels, which may displace and/or disturb birds.		Construction and commissioning of support infrastructure associated with mine infrastructure for crushing and haul-out will increase dust emissions, which may affect surrounding vegetation and, consequently, birds (Farmer, 1993).	
			Blasting (1-2 times per week) and drilling of in-situ rock during open pit mining will increase dust emissions, which may affect surrounding vegetation and, consequently, birds (Farmer, 1993).	

Table 6.9-10 Direct and Indirect Impacts of the Project on Birds

Impact Type	Direct Impact	Project Phase1	Indirect Impact	Project Phase1
Bird injury and mortality	There is the potential for migratory bird mortality during clearing activities.	C	N/A	N/A
	Birds (particularly injured or fledgling) birds may get trapped in the open pit or collide with other Project infrastructure (crushers or trucks), which could lead to death or injury.	O	Vehicle activity for transportation of personnel and operating supplies may cause bird injury or mortality.	C, O, D
			Heavy machinery operation during open pit development, road construction, and construction of mine infrastructure for crushing and haul-out may cause bird injury or mortality.	
Attraction and disorientation	Birds may become attracted to or disoriented by open pit lighting at night, particularly during periods of migration, which could lead to mortality (Jones and Francis, 2003).	O	Artificial lighting at night has been shown to influence the seasonal start of bird vocalizations, which could affect individual fitness (Da Silva et al., 2014).	O
Malfunctions and Accidents: Accidental spills of contaminants in up-grade work areas have the potential to drain into down-gradient wetlands, and can cause negative impact use of these habitats by birds.				C, O, D

1 C = Site Preparation and Construction Phase O = Operation and Maintenance Phase D = Decommissioning and Reclamation

6.9.7 Mitigation and Monitoring

The potential effects related to migratory birds and that are associated with the different phases of the Beaver Dam Mine Project are outlined in Table 6.9-11.

In order to verify the accuracy of the environmental assessment and the effectiveness of mitigation measures, a follow-up monitoring program is recommended. It is recommended that monitoring be conducted from the start of construction until the end of the decommissioning phase.

- Verify the effectiveness of mitigation measures related to light and, based on advice from appropriate jurisdictions, implement adaptive measures, if appropriate;
- Reduce impact of light pollution on birds by minimizing on-site lighting while still allowing for safe operation and by installing lighting which faces the ground, thereby minimizing overall light pollution in the PA;
- Monitor known nests around stockpiles and exposed areas from a distance with a spotting scope or binoculars to verify the effectiveness of the buffer until the nests are inactive;
- Conduct routine inspections as directed by regulators. Inspections are anticipated to be conducted daily by operators, and as required by qualified avian experts during construction, operation and pit re-filling of the open pit area to remove any trapped or injured birds; and
- Notify Environment and Climate Change Canada within 24 hours in the event of the mortality or injury of ten or more migratory birds in a single event or in the event of the mortality or injury of a migratory bird SAR.

The mitigation measures outlined above are also applicable to the Touquoy facility for the processing of Beaver Dam ore. Mitigation measures will be applied to reduce the potential environmental impacts of the Project on migratory birds at the Touquoy facility as per existing operational approvals.

Table 6.9-11 Direct and In-Direct Mitigation to reduce impact on Birds

Mitigation Type	Details	Direct Impacts	Indirect Impacts
PRE-CONSTRUCTION			
Baseline monitoring	- Conduct a pre-construction survey of known raptor nests in the PA during the breeding season (beginning of April to end of August; EC, 2015). Where active nests are recorded, follow timing restrictions or mitigation developed in consultation with Environment and Climate Change Canada and provincial regulators. - If an osprey, bald eagle, or northern goshawk nest is found within the forested areas to be cleared, even outside of the breeding season, a buffer zone appropriate to the species (as determined in consultation with NSDNR) would be placed around the nest and clearing would only occur outside of the buffer zone.	Y	Y
CONSTRUCTION PHASE			
Bird awareness and management	- Avoid construction on native vegetation during the breeding season for migratory birds where practical (beginning of April to end of August for migratory birds; ECCC 2015). Where this is not possible, a bird nest mitigation plan should be developed prior to construction and in consultation with Environment and Climate Change Canada and provincial regulators. - To discourage ground-nesting or burrow-nesting species (such as common nighthawk and bank swallows), large piles or patches of bare soil should not be left uncovered or un-vegetated during the breeding season, wherever possible. - Should any ground- or burrow-nesting species initiate breeding activities on stockpiles or exposed areas, the Proponent will work with Environment and Climate Change Canada and Nova Scotia Environment to develop buffer and non-disturbance distances and zones that incorporate adaptive management.	Y	Y

Table 6.9-11 Direct and In-Direct Mitigation to reduce impact on Birds

Mitigation Type	Details	Direct Impacts	Indirect Impacts
Best management practices	- Maintain speed limits on mine roads (max. 50 km/hr. within mine footprint, 70 km/hr. along haul road). Reduce speed limit and install signage where specific wildlife concerns have been identified. - Noise controlled by attenuation (the distance between a noise source and a receptor), vertical separation, and equipment design where feasible. - Where there are increased dust emissions, apply water obtained from settling ponds. - Reduce light pollution on site by installing downward-facing lights on site infrastructure and haul roads. Wherever possible, install motion-sensing lights to ensure lights are not turned on when they are not necessary.	Y	Y
Wetland compensation	- Compensate for lost wetland functions that support migratory birds as part of the wetland compensation plan that will be submitted to Nova Scotia Environment.	Y	Y
OPERATION PHASE			
Best management practices	- Only use direct and focused light when needed for worker safety. - Monitor the open pit for trapped birds before the daily start of construction, or prior to resuming work after a shutdown and remove birds before start-up. - Reduce light pollution on site by installing downward-facing lights on site infrastructure and haul roads. Wherever possible, install motion-sensing lights to ensure lights are not turned on when they are not necessary.	Y	N
DECOMMISSIONING			
Best management practices	- Implement reduced speed zones for Project vehicles traveling within the PA. - Where there is potential to infringe on SOCI species-specific setbacks, the EPP will document the locations of the SOCI and define appropriate mitigation measures. - Decommissioning vehicles and personnel will stay within the construction areas - All refueling activities should occur more than 30m from any identified habitats.	Y	Y

6.9.8 Residual Effects and Significance

The predicted residual environmental effects of the Project on birds and bird habitat are assessed to be adverse, but not significant. The overall residual effect of the Project on birds and bird habitat is assessed as not significant after mitigation measures have been implemented.

Table 6.9-12 Residual Environmental Effects for Birds

Project - VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
Clearing and grubbing	Bird awareness and management	A	M	PA	MT	O	IR	HD	Habitat Loss	Not Significant
Heavy machinery operation	Best management practices	A	L	PA	MT	R	R	MD	Disturbance	Not Significant
Vehicle activity for transportation of personnel and operating supplies	Best management practices	A	L	PA	MT	R	R	MD	Disturbance	Not Significant
Construction and commissioning of support infrastructure	Bird awareness and management	A	M	PA	MT	O	R	MD	Habitat Loss	Not Significant
Widening of existing road and construction of new portion of haul road	Bird awareness and management	A	M	PA	ST	O	IR	MD	Habitat Loss	Not Significant
Open pit and other site lighting	Best management practices See mitigation	A	L	PA	MT	R	R	MD	Attraction and disorientation	Not Significant
Blasting and drilling of in-situ rock	Best management practices See mitigation	A	M	PA	ST	R	R	LD	Disturbance	Not Significant
Haul truck activity	Best management practices	A	M	PA	MT	R	R	MD	Disturbance/ Mortality	Not Significant
Primary crushing of ore	Best management practices	A	M	PA	MT	R	R	MD	Disturbance	Not Significant

Table 6.9-12 Residual Environmental Effects for Birds

Project - VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		

Legend (refer to Table 5.10-1 for definitions)

Nature of Effect		Geographic Extent		Frequency		Ecological and Social Context	
A	Adverse	PA	Project Area	O	Once	LD	Low Disturbance
P	Positive	LAA	Local Assessment Area	S	Sporadic	MD	Moderate Disturbance
		RAA Area	Regional Assessment	R	Regular	HD	High Disturbance
Magnitude				C	Continuous		
N	Negligible	**Duration**		**Reversibility**			
L	Low	ST	Short-Term	R	Reversible		
M	Moderate	MT	Medium-Term	IR	Irreversible		
H	High	LT	Long-Term				
		P	Permanent				

6.9.9 Proposed Compliance and Effects Monitoring Program

As the Project moves forward, monitoring programs will proceed to gather pre-construction bird baseline data. Monitoring programs will continue as indicated during Project phases to verify baseline conditions and to determine the effects of the Project on birds in the PA. Section 6.9.7 summarizes the mitigation and monitoring activities that will be completed. The details of the monitoring programs will be determined in consultation with regulatory agencies and will be described in the application for an IA for the site operations following the EA process. High level detail is needed in this application and would be subject to review by NSE and other agencies. An EMS and EPP will be developed as part of the Project implementation that will confirm the responsibility and system of accountability for the compliance and effects monitoring program.

The objectives of the bird monitoring programs are to:

- Verify effects predicted in the EIS;
- Confirm the continuing effectiveness of mitigation measures;
- Identify the need for any new mitigation measures; and
- Confirm compliance with regulatory approvals and requirements.

Bird monitoring programs will include the following, as well as additional monitoring as determined through discussions with regulatory agencies:

- A follow-up monitoring program is recommended to be conducted from the start of construction until the end of the decommissioning phase as appropriate based on monitoring results;
- Monitor known nests around stockpiles and exposed areas from a distance with a spotting scope or binoculars to verify the effectiveness of the buffer until the nests are inactive;
- Conduct routine inspections as directed by regulators. Inspections are anticipated to be conducted daily by operators, and as required by qualified avian experts during construction, operation and pit re-filling of the open pit area to remove any trapped or injured birds; and
- Notify Environment and Climate Change Canada within 24 hours in the event of the mortality or injury of ten or more migratory birds in a single event or in the event of the mortality or injury of a migratory bird SAR.

6.10 Species of Conservation Interest and Species at Risk

6.10.1 Rationale for Valued Component Selection

SAR are protected under federal or provincial endangered species legislation. These pieces of legislation outline protection of these species and their habitats in the form of species-specific recovery strategies and action plans. The level of protection offered to a listed species varies depending on its designation. SOCI represent species whose populations are either currently or potentially threatened by natural or anthropogenic factors. These species are found on the ACCDC lists S1-S3. Natural systems and ecological processes often depend on healthy, diverse ecosystems. As such, understanding the distribution and diversity of rare species present within a

PA is key to proper risk assessment, Project planning, and mitigation of risks posed to rare species by a given project.

6.10.2 Baseline Program Methodology

Specific field program methodologies for each taxonomic group are outlined in previous sections of this EIS (Fish and Fish Habitat, Flora and Habitat, Terrestrial Fauna, and Birds). These chapters describe the detailed and specific field program methods (if any) to identify SAR and SOCI within the PA. Specific field program methods are shown on Figures 6.10-2 and 6.10-2A to 6-10-2L.

6.10.2.1 Priority Fish Survey Methods

No targeted methods were employed specifically for priority fish species. The diversity of fish survey methods employed (eel pots, fyke nets, minnow traps, and electrofishing) were used with the goal of capturing the broadest diversity of fish species present within the PA. Section 6.6.2 outlines detailed fish survey methods used in the PA.

6.10.2.2 Priority Vascular Flora Survey Methods

No specific targeted surveys for priority vascular plant species were completed. Botanical surveys were completed in all habitats throughout the PA to compile a comprehensive list of vascular flora species present in the PA. Botanists conducting vascular plant surveys thoroughly reviewed the results of the desktop evaluation for vascular flora priority species. This allowed the botanical surveys to focus on habitats with elevated potential for any priority vascular flora species. Vascular flora survey methods are outlined in Section 6.7.2

The following information was collected for any priority vegetation species identified during field surveys: site location, date, scientific name, count, size, habitat, location (UTM NAD83 CSRS), along with a photograph and any relevant comments. Any specimens that could not be identified in the field were photographed in order to aid in identification.

6.10.2.3 Priority Lichen Survey Methods

Prior to undertaking the field assessment, a detailed desktop review of known lichen observations and potential habitat for rare lichens within and surrounding the PA was conducted. The desktop review involved three components: a review of the list of priority species, a review of predictive habitat mapping for boreal felt lichen (provided by NSDNR), and reviewing the results of habitat mapping.

To develop the predictive habitat maps for boreal felt lichen, NSDNR used an algorithm which identifies all forest stands in the provincial forestry database in which balsam fir (*Abies balsamea*) is listed as a primary or secondary species and which occur within 80 m of a mapped bog or fen. The model further confines the search to only those forest stands located within 30 km of the Atlantic Coast. This was used to predict areas with a higher potential of locating boreal felt lichen. This data set was reviewed in advance of field assessment and was uploaded onto the GPS units during field assessments. Other habitats identified by the Project team as suitable for rare lichens were surveyed for lichens as well.

While the specific habitat requirements of each of priority lichen species varies slightly, they all require mature to over-mature forests. Stand age is one of the greatest determinants of lichen diversity (McMullin, Duinker, Cameron, Richardson, & Brodo, 2008). Within the PA, mature to over-mature stands are infrequent, with the majority of the PA having been harvested for timber production. Intact, natural, mature stands are more frequent within the haul road PA than within the mine footprint PA. Lichen surveys throughout the PA were focused on undisturbed stands, particularly those located near mapped wetlands, as these habitats have elevated potential for identifying priority lichen species.

All suitable habitats within the PA were surveyed in May 2015 (mine footprint PA and surrounding area) and May 2016 (haul road PA) for priority lichen species. The survey area was extended beyond the PA boundary in the vicinity of the mine footprint so the Project Team could understand the distribution of rare lichens in a broader context. This broadened lichen study area allowed the Project Team to form conclusions based on lichen populations, rather than individual lichens. The lichen study area surrounding the mine footprint PA is shown on Figure 6.8-1.

Mature trees that are appropriate for hosting priority lichen species were visually inspected. The visual inspection focused on tree trunks, but included branches and twigs where it was determined to be safe and appropriate. The following information was collected for any priority lichen species identified during field surveys: site location, date, scientific name, count, size, habitat (host tree and general habitat), location (waypoint in UTM NAD83), height of the specimen, direction that the specimen was facing, along with a photograph and any relevant comments. Any specimens that could not be identified in the field were photographed in order to aid in identification.

6.10.2.4 Mainland Moose Survey Methods

To determine the level of concern associated with mainland moose, the Project team commenced by consulting with the Endangered Mainland Moose Special Management Practices report (NSDNR, 2012) and the Status Report on the Eastern Moose (Parker, 2003). In addition, on January 5, 2015, the Project team consulted with Regional Wildlife Biologist, Shavonne Meyer, to request a record of all mainland moose sightings identified within a broad vicinity of the PA.

Tracking surveys were completed to determine if mainland moose are present within the mine footprint PA. Six transects, totaling nine-kilometers in length, were established through representative habitat types. An observer capable of identifying moose and deer tracks, browse and scat completed the moose track surveys. Three winter tracking surveys were completed along these transects on January 14, February 18, and March 17, 2015. One moose pellet group inventory (PGI) survey was completed along these same transects on May 25, 2015

Winter and spring moose surveys, consisting of eight one-kilometer transects, were completed within the haul road PA in March and April 2016. Typically, winter track surveys would be completed three times, following the same transects, in suitable winter tracking conditions, followed by a single round of spring PGI surveys. Winter track conditions and a lack of snow cover during the late winter of 2016 prevented the repetition of winter track surveys for Moose. On February 26, 2016, the Project team consulted with the Regional Wildlife Biologist, Shavonne Meyer, the provincial Large Mammal Biologist, Peter MacDonald, and with the provincial SAR Biologist, Mark Elderkin to discuss a change in methodology to reflect the lack of snow cover. Through this consultation, the Project team determined that one winter track survey would be complemented by repeated spring PGI surveys. Each PGI survey would be completed along a different series of transects, thereby increasing the coverage of the surveys, while still obtaining the data that would be necessary to make conclusions related to moose activity within the haul road PA. In total, 18 one-kilometer transects were established along the Haul Road. One winter track survey was completed on transects 1-8 on March 2, 2016. This was complemented by two sets of PGI surveys completed on March 16th, 2016 (Transects 9-18) and on April 26th, 2016 (Transects 1-8). Locations of moose and deer tracks, browse, and scat were recorded using a handheld GPS unit. Incidental observations of other wildlife species, tracks, and scat were also recorded. The placement of moose survey transects through the PA reflected a mixture of existing roads and intact forest, and were determined in consultation with NSDNR staff identified above. Mainland moose survey transects are identified on Figure 6.10-1.

6.10.2.5 Bat Survey Methods

A desktop analysis of potential bat habitat was conducted to determine level of concern associated with the Project and to determine whether field assessments were necessary. The desktop analysis started with a review of bat occurrences, as noted in the ACCDC reports. The Significant Species and Habitat Database was also searched for known potential bat hibernacula. According to NSDNR SAR Biologist, Mark Elderkin, bats are sensitive to activity up to 1 km away during hibernation. As such, a minimum of 1 km buffer is recommended when assessing risk to bat SAR. Provincial government records for AMOs were reviewed (Hennick and Poole, 2016) within a 10 km radius of the site, as these AMOs potentially provide bat hibernacula. These records were reviewed for mine shaft type, access, original depth, and presence of water in the shaft to determine likelihood that the AMO is potential bat hibernacula. The records identified twelve AMOs within the mine footprint. The twelve AMOs within the mine footprint (Figure 6.8-1) were evaluated in the field on September 18, 2014 for their potential to provide bat hibernacula. During all other surveys completed within the PA by the Project team, biologists were trained to evaluate landscapes for potential hibernacula including natural caves or anthropogenic mine openings or abandoned wells.

6.10.2.6 Priority Herpetofauna Survey Methods

Wood turtles and snapping turtles have been identified as priority species with the potential to be present within the PA based on habitat preference and known distribution. The wood turtle is listed as threatened by COSEWIC, NSESA and SARA. This species prefers clear rivers, streams, or creeks with moderate current and sandy or gravelly substrate (ECCC, 2016c). The snapping turtle is listed as vulnerable in NS and is listed as a species of special concern by COSEWIC and SARA. This species occurs in almost any freshwater habitat, though it is most often found in slow-moving water with a soft mud or sand bottom and abundant vegetation (ECCC, 2016d).

Seven wood turtle surveys were conducted from May 17 to June 4, 2015 along the watercourse that runs between Crusher Lake and Mud Lake (part of watercourse 5) within the mine footprint PA. No other suitable wood turtle habitat was identified across PA (mine footprint and haul road) that warranted a detailed survey for wood turtles. MEL biologists continued to look for signs of turtle usage during all other site surveys, particularly suitable nesting habitat along watercourse crossings throughout the haul road PA.

Wood turtles are often associated with some form of vegetative structure, therefore, MEL field staff searched for turtles at the base of woody shrubs, under or near deadfall, and amongst grasses or leaf litter. The ground and undergrowth was searched from the water's edge inland to 20 meters along one side of the watercourse.

Wood turtles are active in temperatures over 9 °C, but best results are found when temperatures range from 15-20 °C. Wood turtle observations drop off significantly when temperatures exceed 25 °C. Ambient temperature appears to be as good an indicator of the probability of detection as sunlight so surveys can occur on cloudy days. As long as the air temperature is warmer than the water, there is a thermal advantage in basking on land (ECCC, 2016c). Surveys were completed between 10:00 and 18:00 hours.

Opportunistic observations for snapping turtles and suitable habitat were documented through all field programs, particularly wetland and watercourse evaluations. Biologists conducting field assessments searched for snapping turtles in aquatic ecosystems with slow moving water, mucky substrate, and dense vegetation. During June, particular attention was paid to identifying snapping turtles or signs thereof (i.e. scrapes, depredated nests) along exposed gravel including roadside shoulders, when snapping turtles move to these habitats to nest.

The PA was also surveyed for herpetofauna during other field programs, particularly wetland and watercourse assessments, with special attention paid towards identifying any signs of turtle usage. Signs such as animal sightings, vocalizations, amphibian egg masses, cast snake skins, turtle nest scrapes, or depredated nests were recorded during any field programs by biologists capable of recognizing these signs.

6.10.2.7 Priority Invertebrate Survey Methods

A desktop review for rare invertebrates was completed. This included reviewing species records in the vicinity of the PA provided by Odonata Central, the Maritime Butterfly Atlas, and the ACCDC reports for Odonates, Lepidopterans and all other invertebrates, respectively. Incidental observations for priority invertebrates occurred during all field programs, particularly wetland and watercourse delineation, and fish habitat surveys. Incidental observations of odonates and lepidopterans include live adults or larvae, or cast skins. Signs of molluscs include live or dead individuals and shells.

6.10.2.8 Priority Bird Survey Methods

The second atlas of the MBBA was reviewed to determine possible, probable, and confirmed records of breeding avian SAR and SOCI in proximity to the PA. The PA falls within four 10 km^2 MBBA survey squares (20NQ18, 20NQ19, 20NQ28, 20NQ29). The results of MBBA surveys are presented in Section 6.9.3, and provided in **Appendix L.**

Targeted surveys for the common nighthawk were completed throughout the PA, as described in Section 6.9.2.9.2. Suitable habitat is available for this species within the PA, therefore, dedicated surveys for the common nighthawk were conducted from mid- to end of June at either dawn (1 hour before sunrise to 30 minutes after sunrise) or dusk (30 minutes before sunset to an hour after sunset), as described in the Common Nighthawk Survey Protocol (Saskatchewan Ministry of Environment, 2015). Stations were spaced at least 800 m apart and a point count survey with call playback was used to detect the presence of common nighthawk within the PA. A three-minute passive point count was conducted at each station, followed by a call playback which includes 30-seconds of the conspecific common nighthawk call followed by 30-seconds of silence (or passive surveying), repeated for three-minutes (i.e., three times). The total time spent at each survey point was a minimum of six-minutes. Three call playback stations were surveyed within the mine footprint PA and 12 call playback stations were surveyed within the haul road PA, for a total of 15 call playback stations within the PA.

No other targeted surveys for priority bird species were conducted, as all other species are anticipated to be detectable during standard methods for bird surveys.

6.10.3 Baseline Conditions

6.10.3.1 Priority Fish Species

The desktop evaluation for priority fish species revealed that no priority species were documented within 5 km of the PA by the ACCDC reports provided for the mine footprint and for the haul road. No location sensitive species of fish have been identified within 5 km of either the mine footprint or the haul road PA. The following priority fish species are identified as having an elevated potential to be located within the PA, based on habitat preferences, and broad geographic range.

Table 6.10-1 Priority fish species with elevated potential for being identified within the Project Area

Latin Name	Common Name	SARA, COSEWIC NSA	S-Rank
Anguilla rostrata	American Eel	COSEWIC	S5
Salmo salar	Atlantic salmon – Southern Uplands Population	COSEWIC Endangered	S2
Culaea inconstans	Brook Stickleback		S3
Osmerus mordax (landlocked)	Rainbow Smelt		S3
Rhinichthys atratulus	Blacknose Dace		S3

As described in Section 6.6.2, all fish survey methods were designed to identify the diversity of species within the diversity of habitats present within the PA, including any priority species. Field survey locations for various fish programs are shown on Figures 6.3-3 and 6.3-3A to 6.3-3L. No specific targeted surveys were completed for priority fish species. Within the mine footprint PA, no priority fish species were identified during any of the suite of survey methods. Although they were not observed, the American eel, Atlantic salmon, and Blacknose dace have suitable habitat within the mine footprint PA, and therefore may be present.

Two SOCI were identified during electrofishing within watercourses within the haul road PA. The American eel is currently listed as threatened by COSEWIC. It was identified during electrofishing surveys in watercourses N, V, and AH. A single Blacknose dace was observed in watercourse N within the haul road PA as well. Atlantic salmon have been documented within the WRSH watershed and are expected to be present within contiguous surface water with the West River Sheet Harbour where suitable habitat is present within the haul road PA.

According to the Nova Scotia Salmon Association (pers. comm. 2016), Rainbow smelt and brook stickleback are not known to be present within the WRSH or Tangier River systems. Therefore, the likelihood of these species being present within the PA is very low.

No fish SAR were documented during any fish surveys.

The Project Team received a letter from Lisa Poan, Fisheries Protection Biologist at Fisheries and Oceans Canada on April 20, 2015 (Entitled: DFO response to notification letter pursuant to subsection 79(1) of the Species At Risk Act for the Proposed Beaver Dam Mine Project). This letter indicated that the American eel and the Atlantic salmon (Southern Upland population) are under review for protection under SARA. If designated under Schedule 1 of SARA as proposed, prohibitions would immediately come into effect under Sections 32 and 33 of SARA. As such, the Project Team is moving forward with the Projects' effects assessment, with the assumption that these species may soon be protected under SARA.

6.10.3.1.1 Blacknose Dace

A single Blacknose dace was observed at watercourse N within the haul road PA (West River Sheet Harbour). The single individual had a total length of 9.0 cm and is presumed to be a mature fish. This single fish was identified along with a common assemblage of freshwater species, including yellow perch, white sucker, banded killifish, American eel, and lake chub. The Blacknose dace prefers moderately flowing watercourses with rocky substrate, but can be found in slower moving areas as well, similar to habitat present in West River Sheet Harbour. They feed primarily on aquatic invertebrates and provide a prey source for a variety of species, including salmonids and piscivorous birds (Canadian Rivers Institute, n.d.). The single observation of Blacknose dace does not allow conclusions about abundance or distribution of the population, but it does confirm presence within the West River Sheet Harbour watercourse system.

6.10.3.1.2 American Eel

Thirty-six mature American eels were observed within three watercourses within the Haul Road PA, and none were observed within the mine footprint PA. The average length of individuals captured was 24.0 cm (minimum: 10 cm, maximum: 45 cm). American eels were observed in watercourse N (West River Sheet Harbour) along with Blacknose dace, yellow perch, white sucker, banded killifish and lake chub, and in watercourses V and AH, along with brook trout. Watercourse V is the West River Sheet Harbour and watercourse AH is a tributary to the Morgan River, within the Tangier River Secondary Watershed. Wetlands contiguous with watercourses which actually or potentially support American eel may also support American Eel, as outlined in Table 6.5-4 and in Section 6.6-3.

Within the PA, the American eel was observed in watercourses associated with the Haul Road. While no American eel were observed within the mine footprint PA, absence cannot be confirmed.

The American eel is listed as special concern under COSEWIC. It is not currently listed under SARA or NSESA, and the Nova Scotia Provincial Status Rank is secure (S5, according to ACCDC).

As a catadromous species, eels spend the majority of their lives in freshwater, moving to the Sargasso Sea to spawn. Their distribution includes marine waters of the western Atlantic Ocean and some freshwater systems connected to the Atlantic Ocean in South America, North America, and Greenland. Within the freshwater environment, mature American eels are habitat generalists, frequently found in natural watercourses that offer structural complexity and shade in the form of coarse woody debris, varied substrate, in-stream vegetation, and an available food source of forage fish, invertebrates, molluscs, and vegetation.

Fish habitat was assessed for various lifecycles of the American eel. Migration habitat was determined based on a contiguous fresh water system connecting two separate waterbodies. Juvenile habitat requires various benthic substrates, woody debris, and/or vegetation for protection and cover. Overwintering habitat required mud/silt sections of streambeds with depths of a minimum 30 cm to ensure the eels do not freeze to death during winter months.

Potential American eel habitat was found to be within 30 tributary watercourses to the three confirmed eel bearing watercourses. Tributary systems were inferred using both field data and NS topographical watercourse mapping. A review of literature documents that American eels are not restricted to contiguous watercourses and possess the ability to traverse over land in wet, low lying grass habitats (MacGregor et al., 2011). As such, all remaining watercourses within the Beaver Dam Mine Project are believed to be potentially accessible to the American eel, even if habitat provision in those watercourses is low.

These classifications are based in some cases on very short sections of watercourses evaluated within the PA only and, therefore, should be considered as preliminary summaries of fish habitat potential, with detailed evaluation necessary during the permitting stages of this Project to confirm fish habitat. Table 6.10-2 below provides a summary of potential American eel bearing watercourses.

Table 6.10-2 Summary of Potential American Eel-bearing Watercourses

American Eel Habitat	Watercourse*	Watershed	Life Cycle		
			Migration	Juvenile	Overwintering
Confirmed: American eel presence has been confirmed through the MEL electrofishing program June 2016.	N (West River Sheet Harbour)	Brandon Lake / Rocky Brook Lake	✓	✓	✓
	V	Lake Alma	✓	✓	✓
	AH	Rocky Lake	✓	✓	✓
High Potential: Watercourses that are confirmed or inferred tributaries to watercourses N, V, and AH, which provide a combination of suitable migration,	A	Tent Lake		✓	
	B	Tent Lake		✓	
	C	Tent Lake		✓	
	D	Tent Lake		✓	
	F	Brandon Lake	✓	✓	✓
	G	Brandon Lake	✓	✓	✓

Table 6.10-2 Summary of Potential American Eel-bearing Watercourses

American Eel Habitat	Watercourse*	Watershed	Life Cycle		
			Migration	Juvenile	Overwintering
juvenile, or overwintering habitat.	H	Brandon Lake		✓	✓
	I	Brandon Lake		✓	
	J	Brandon Lake		✓	
	K	Brandon Lake		✓	
	L	Brandon Lake		✓	✓
	M	Brandon Lake		✓	✓
	O	Lake Alma	✓	✓	
	P	Lake Alma		✓	✓
	Q	Lake Alma		✓	
	R	Lake Alma		✓	
	S	Lake Alma		✓	
	T	Lake Alma	✓	✓	
	U	Lake Alma		✓	✓
	W	Lake Alma		✓	
	X	Lake Alma		✓	✓
	Y	Lake Alma		✓	✓
	Z	Lake Alma		✓	✓
	AA	Eagles Nest	✓	✓	✓
	AB	Eagles Nest		✓	
	AC	Eagles Nest		✓	
	AD	Eagles Nest	✓	✓	✓
	AE	Rocky Lake		✓	
	AF	Rocky Lake		✓	✓
	AG	Rocky Lake		✓	✓
Potential: Watercourses assessed to have a combination of migration, juvenile, or overwintering American eel habitat, but do not have a topographically mapped connection to a watercourse in which American eel were observed (i.e., no mapped connection to watercourses N, V, or AH).	1	Tent Lake		✓	
	2	Cameron Flowage		✓	
	3	Cameron Flowage		✓	
	4	Cameron Flowage		✓	
	5 (top near WL2)	Cameron Flowage		✓	
	5 (lower near WL14)	Cameron Flowage	✓	✓	✓
	6	Cameron Flowage		✓	
	7	Cameron Flowage		✓	
	8	Cameron Flowage		✓	
	9	Cameron Flowage		✓	
	10	Kent Lake		✓	
	11	Kent Lake		✓	✓
	12	Cameron Flowage		✓	
	13	Cameron Flowage		✓	

Table 6.10-2 Summary of Potential American Eel-bearing Watercourses

American Eel Habitat	Watercourse*	Watershed	Life Cycle		
			Migration	Juvenile	Overwintering
	14	Cameron Flowage		✓	✓
	E	Brandon Lake		✓	

Numbered watercourses lie within the mine footprint, lettered watercourses lie along the Haul Road.

According to COSEWIC (COSEWIC, 2013), the Maritimes region falls within the American eel's Freshwater Ecological Area 3 (FEA3). This population has had some recorded population level fluctuations, lacking an overall trend between 1989 and 2002. The St. Lawrence River and Great Lakes (FEA1) population has experienced significant reduction in populations since the early 1980s. Given that the entire population spawns in the Sargasso Sea, the reduction of any individual population or reduction in range can affect the total abundance of the species, even if all populations are not experiencing the same decline.

Threats to the abundance and distribution of the American eel include a variety of natural and anthropogenic factors that result in direct mortality or indirect impacts to quality and access to habitat. Some hydroelectric dams can prevent or limit upstream migration of eels, while resulting in direct mortality to downstream migrants. Overfishing has contributed to population reduction, as well as the spread of an introduced parasite (*Anquillicola crassus*), changes to accessibility of habitat through installation of barriers, and potential impact to quality of habitat from land use practices and climate change (COSEWIC, 2013).

6.10.3.1.3 Atlantic Salmon

According to COSEWIC (2010), the Southern Uplands Population of Atlantic salmon (*Salmo salar*) is listed as endangered and is considered imperiled provincially by the ACCDC (ranked S2). This population is not currently protected under SARA or NSESA. Atlantic salmon are divided into unique populations, based on genetic distinction and range. For the purposes of this discussion, we are considering only the Southern Uplands (SU) Population, as outlined by DFO in the Recovery Potential Assessment for the Southern Uplands population of Atlantic salmon (Fisheries and Oceans Canada, 2013).

Atlantic salmon was not observed during any fish sampling programs within the PA (mine footprint and haul road). However, this species has been extensively documented within the West River Sheet Harbour and the Killag River by the Nova Scotia Salmon Association and is presumed to be present in several tributaries to these watercourses, including tributaries found within the PA. Wetlands contiguous with watercourses which potentially support Atlantic salmon may also support Atlantic salmon, as outlined in Table 6.5-4 and in Section 6.9-3.

Southern Upland (SU) Atlantic salmon have been found along the entire coast of Nova Scotia, from the Bay of Fundy to Cape Breton. However, the full extent of the range of SU population is not fully known. The SU Atlantic salmon spawn in fresh water from October to November and spend one to four years as juveniles in the fresh water. The majority of the juveniles migrate to the sea after two years of being in fresh water. In spring, the salmon leave the rivers and by mid-summer migrate to the Atlantic Ocean by Newfoundland and Labrador. They spend one to three years in the Atlantic

Ocean before returning as adults to fresh water to spawn. The majority of adults leave the rivers in spring after spawning and recondition out at sea before spawning in freshwater again. Within the freshwater environment, the SU Atlantic salmon is found in cool, clear, well-oxygenated waters which support a reliable food source of aquatic invertebrates. Gravel and cobble is the preferred substrate for spawning (Fisheries and Oceans Canada, 2013; Fisheries and Oceans Canada, 2016a).

The Nova Scotia Salmon Association has documented the presence of Atlantic salmon in three watercourses near the Beaver Dam Mine Project, West River Sheet Harbour, Killag River, and Little River. Fish habitat was assessed within West River Sheet Harbour (watercourse N) as Type I and the Killag River (Cameron Flowage) as Type II within the PA.

Potential Atlantic salmon habitat was found to be within 22 tributary watercourses to the three documented salmon bearing watercourses within the PA. Tributary systems were inferred using both field data and NS topographical watercourse mapping. Only tributaries that were observed to have Type I, Type II, and Type III Fish Habitat were counted.

An additional 10 watercourses in the PA were assessed to have potential Atlantic salmon habitat. Potential Atlantic salmon habitat was determined as watercourses with Type I or Type II Fish Habitat without a confirmed or inferred connection to a documented salmon-bearing watercourse.

Fish habitat potential is described based on the categories identified by Beak (1980) and detailed in the NL Guide referenced herein. These classifications are based in some cases on very short sections of watercourses evaluated within the PA only and, therefore, should be considered as preliminary summaries of fish habitat potential, with detailed evaluation necessary during the permitting stages of this Project to confirm fish habitat. Table 6.10-3 below provides a summary of potential Atlantic salmon bearing watercourses.

Table 6.10-3 Summary of Potential Atlantic Salmon-bearing Watercourses

Atlantic Salmon Habitat	Watercourse*	Watershed	Fish Habitat		
			Type I	Type II	Type III
Documented: Salmon presence has been confirmed through the Atlantic Salmon Association.	N (West River Sheet Harbour)	Brandon Lake / Rocky Brook Lake	✓		
	Cameron Flowage (Killag River)	Cameron Flowage		✓	
High Potential: Watercourses that are confirmed or inferred tributaries to West River Sheet Harbour or Killag River and were observed to have	4	Cameron Flowage		✓	
	5 (lower near WL14)	Cameron Flowage		✓	
	7	Cameron Flowage		✓	
	9	Cameron Flowage		✓	
	14	Cameron Flowage		✓	
	B	Tent Lake		✓	

Table 6.10-3 Summary of Potential Atlantic Salmon-bearing Watercourses

Atlantic Salmon Habitat	Watercourse*	Watershed	Fish Habitat		
			Type I	Type II	Type III
Type I, II or III Fish Habitat.	C	Tent Lake		✓	
	F	Brandon Lake		✓	
	G	Brandon Lake		✓	
	H	Brandon Lake			✓
	I	Brandon Lake		✓	
	J	Brandon Lake		✓	
	L	Brandon Lake	✓		
	M	Brandon Lake		✓	
	P	Lake Alma	✓		
	Q	Lake Alma	✓		
	T	Lake Alma		✓	
	U	Lake Alma		✓	
	V	Lake Alma			✓
	X	Lake Alma		✓	
	Y	Lake Alma		✓	
	Z	Lake Alma		✓	
Potential: Watercourses assessed to have Type I and Type II Fish Habitat, but do not have a topographically mapped connection to a documented Salmon river.	10	Kent Lake		✓	
	12	Cameron Flowage		✓	
	E	Brandon Lake	✓		
	S	Lake Alma		✓	
	AA	Eagles Nest		✓	
	AC	Eagles Nest		✓	
	AD	Eagles Nest	✓		
	AE	Rocky Lake		✓	
	AF	Rocky Lake		✓	
	AH	Rocky Lake	✓		
*Numbered watercourses lie within the mine footprint, lettered watercourses lie along the Haul Road.					

Atlantic salmon are highly sensitive to fluctuations in habitat conditions, particularly pH and temperature. As such, many land use practices and impacts to the freshwater ecosystem can affect the abundance and distribution of salmon. Physical barriers (e.g., dams, improperly installed culverts, etc.) can limit the distribution of the species and fish harvesting can affect their abundance. The Nova Scotia Salmon Association, recognizing the impact low pH on salmon in the West River Sheet Harbour, has been operating an acid mitigation project on the West River for over 10 years.

This involves a lime dosing station which increases the pH of the water to a suitable range for juvenile salmon. This project has resulted in significant increase in smolt populations and improved overall habitat quality within the West River Sheet Harbour.

According to the Nova Scotia Salmon Association (E. Halfyard, pers. comm. 2016), a second lime dosing station is proposed to be installed along the Killag River, which currently provides significant spawning and rearing habitat for Atlantic salmon. Maintenance of surface water quality and quantity is imperative to the continued success of ongoing salmon restoration efforts in the West River Sheet Harbour and its tributaries.

6.10.3.1.4 Fish SAR & SOCI Summary

No fish SAR were observed within the PA. Two priority species of fish were identified during field surveys, and a third species (SU Atlantic salmon) is expected to be present within the PA. No other fish SAR or SOCI were observed and none are expected based on habitat, species distribution, and survey effort completed within the PA.

6.10.3.2 Priority Vascular Flora Species

The desktop evaluation for priority species of vascular flora revealed that none were identified within 5 km of the PA by ACCDC reports. NSDNR has classified several species as ‘location sensitive’, meaning their exact locations cannot be provided to proponents in ACCDC reports. Instead, ACCDC will simply indicate whether a location sensitive species is documented within 5 km of the PA. Black ash (*Fraxinus nigra*), a location sensitive vascular flora species, was not documented within 5 km of the PA in either ACCDC report (for the mine footprint or the haul road PA).

Table 6.10-4 below provides a list of vascular plant priority species which have elevated potential to be located within the PA based on habitat preferences and known distribution. Species which have been documented within the vicinity of the PA by the Museum of Natural History are highlighted in bold text.

Table 6.10-4 List of priority species with elevated potential to be located within the Project Area

Latin Name	Common Name	SARA, COSEWIC, NSESA Status	S Rank
Lachnanthes caroliniana	Redroot	SARA & COSEWIC Special Concern, NSESA Vulnerable	S2
Potamogeton pulcher	Spotted Pondweed	NSESA Vulnerable	S2S3
Fraxinus nigra	Black Ash	NSESA Threatened	S1S2
Agalinis paupercula	Small-flowered Agalinis		S1
Allium burdickii	Narrow-Leaved Wild Leek		S1?
Allium schoenoprasum	Wild Chives		S2

Allium tricoccum	Wild Leek		S1
Amelanchier nantucketensis	Nantucket Serviceberry		S1
Anemone Canadensis	Canada Anemone		S2
Arabis drummondii	Drummond's Rockcress		S2
Asclepias incarnata ssp. Pulchra	Swamp Milkweed		S3?
Barbarea orthoceras	American Yellow Rocket		S1
Bartonia virginica	Yellow Bartonia		S3
Betula borealis	Northern Birch		S2
Betula pumila var. pumila	Bog Birch		S2S3
Betula pumila var. renifolia	Bog Birch		S1?
Betula michauxii	**Michaux's Dwarf Birch**		**S2**
Botrychium lanceolatum var. angustisegmentum	Lance-Leaf Grape-Fern		S2S3
Botrychium lunaria	Common Moonwort		S1
Bromus latiglumis	Broad-Glumed Brome		S1
Cardamine pratensis var. angustifolia	Cuckoo Flower		S1
Carex adusta	Lesser Brown Sedge		S2S3
Carex alopecoidea	Foxtail Sedge		S1
Carex foenea	Fernald's Hay Sedge		S3?
Carex granularis	Limestone Meadow Sedge		S1
Carex grisea	Inflated Narrow-leaved Sedge		S1
Carex haydenii	Hayden's Sedge		S1
Carex lapponica	Lapland Sedge		S1?
Carex peckii	White-Tinged Sedge		S2?
Carex plantaginea	Plantain-Leaved Sedge		S1
Carex rosea	Rosy Sedge		S3
Carex tribuloides	Blunt Broom Sedge		S3?
Carex tribuloides var. tribuloides	Blunt Broom Sedge		S3?
Carex vacillans	Estuarine Sedge		S1S3
Carex viridula var. elatior	Greenish Sedge		S1
Caulophyllum thalictroides	Blue Cohosh		S2
Crataegus robinsonii	Robinson's Hawthorn		S1?
Crataegus submollis	Quebec Hawthorn		S1?

Cyperus lupulinus	Hop Flatsedge		S1
Cyperus lupulinus ssp. Macilentus	Hop Flatsedge		S1
Cypripedium parviflorum	Yellow Lady's-slipper		S2S3
Cypripedium reginae	**Showy Lady's-Slipper**		**S2**
Dichanthelium acuminatum var. lindheimeri	Woolly Panic Grass		S1?
Eleocharis erythropoda	Red-stemmed Spikerush		S1
Eleocharis ovata	Ovate Spikerush		S2?
Empetrum eamesii	Pink Crowberry		S3
Empetrum eamesii ssp. Atropurpureum	Pink Crowberry		S2S3
Empetrum eamesii ssp. Eamesii	Pink Crowberry		S2S3
Epilobium strictum	Downy Willowherb		S3
Equisetum hyemale	Common Scouring-rush		S3S4
Equisetum hyemale var. affine	Common Scouring-rush		S3S4
Equisetum palustre	Marsh Horsetail		S1
Equisetum variegatum	Variegated Horsetail		S3
Erigeron philadelphicus	Philadelphia Fleabane		S2
Eriophorum gracile	Slender Cottongrass		S2
Eupatorium dubium	Coastal Plain Joe-pye-weed		S2
Festuca prolifera	Proliferous Fescue		S1S2
Fraxinus pennsylvanica	Red Ash		S1
Galium aparine	Common Bedstraw		S2S3
Galium obtusum ssp. Obtusum	Blunt-leaved Bedstraw		S2S3
Geocaulon lividum	Northern Comandra		S3
Geranium bicknellii	Bicknell's Crane's-bill		S3
Goodyera pubescens	Downy Rattlesnake-Plantain		S2
Halenia deflexa ssp. brentoniana	Spurred Gentian		S1?
Hieracium paniculatum	Panicled Hawkweed		S3
Hieracium scabrum var. leucocaule	Rough Hawkweed		S1
Hordeum brachyantherum	Meadow Barley		S1

Humulus lupulus var. lupuloides	Common Hop		S1?
Hypericum dissimulatum	Disguised St John's-wort		S2S3
Hypericum majus	Large St John's-wort		S2
Impatiens pallida	Pale Jewelweed		S2
Isoetes acadiensis	Acadian Quillwort		S3
Juncus dudleyi	Dudley's Rush		S3
Juncus subcaudatus	Woods-Rush		S3
Juncus subcaudatus var. planisepalus	Woods-Rush		S3
Limosella australis	Southern Mudwort		S3
Liparis loeselii	Loesel's Twayblade		S3S4
Listera australis	Southern Twayblade		S3
Lycopodium complanatum	Northern Clubmoss		S3S4
Lycopodium sabinifolium	Ground-Fir		S3?
Lysimachia quadrifolia	Whorled Yellow Loosestrife		S1
Minuartia groenlandica	Greenland Stitchwort		S3
Myriophyllum farwellii	Farwell's Water Milfoil		S2
Ophioglossum pusillum	Northern Adder's-tongue		S2S3
Panicum dichotomiflorum var. puritanorum	Fall Panic Grass		S1?
Panicum tuckermanii	Tuckerman's Panic Grass		S3S4
Pilea pumila	Dwarf Clearweed		S1
Pilea pumila var. pumila	Dwarf Clearweed		S1
Piptatherum canadense	Canada Rice Grass		S2
Plantago rugelii	Rugel's Plantain		S2S3
Plantago rugelii var. rugelii	Rugel's Plantain		S2S3
Platanthera flava var. herbiola	Pale Green Orchid		S2
Platanthera grandiflora	Large Purple Fringed Orchid		S3
Polygala sanguinea	Blood Milkwort		S2S3
Polygonum careyi	Carey's Smartweed		S1
Polypodium appalachianum	Appalachian Polypody		S3?
Potamogeton obtusifolius	Blunt-leaved Pondweed		S3
Potamogeton zosteriformis	Flat-stemmed Pondweed		S2S3
Potentilla Canadensis	Canada Cinquefoil		S2S3

Potentilla canadensis var. Canadensis	Canada Cinquefoil		S2S3
Proserpinaca palustris	Marsh Mermaidweed		S3
Pyrola asarifolia	Pink Pyrola		S3
Pyrola asarifolia ssp. Asarifolia	Pink Pyrola		S3
Ranunculus gmelinii+	Gmelin's Water Buttercup		S3
Ranunculus pensylvanicus	Pennsylvania Buttercup		S1
Ranunculus sceleratus	Cursed Buttercup		S1S2
Ranunculus sceleratus var. sceleratus	Cursed Buttercup		S1S2
Rhamnus alnifolia	**Alder-leaved Buckthorn**		**S3**
Rhinanthus minor ssp. groenlandicus	Little Yellow Rattle		S1
Rosa acicularis	Prickly Rose		S1
Rosa acicularis ssp. Sayi	Prickly Rose		S1
Rudbeckia laciniata	Cut-Leaved Coneflower		S1S2
Rudbeckia laciniata var. gaspereauensis	Cut-Leaved Coneflower		S1S2
Rumex persicarioides	Peach-leaved Dock		S2?
Salix pedicellaris	Bog Willow		S2
Salix sericea	Silky Willow		S2
Salix serissima	Autumn Willow		S1
Saxifraga cernua	Nodding Saxifrage		S1
Schizaea pusilla	Little Curlygrass Fern		S3
Sisyrinchium atlanticum	Eastern Blue-Eyed-Grass		S3S4
Sisyrinchium fuscatum	Coastal Plain Blue-eyed-grass		S1
Solidago latissimifolia	Elliott's Goldenrod		S3S4
Spiraea septentrionalis	Northern Meadowsweet		S1?
Stellaria crassifolia	Fleshy Stitchwort		S1
Stellaria crassifolia var. crassifolia	Fleshy Stitchwort		S1
Stellaria longifolia	Long-leaved Starwort		S2
Stellaria longifolia var. longifolia	Long-leaved Starwort		S2
Symphyotrichum boreale	Boreal Aster		S2?
Symphyotrichum undulatum	Wavy-leaved Aster		S2
Thalictrum venulosum	Northern Meadow-rue		S1

Torreyochloa pallida var. pallida	Pale False Manna Grass		S1
Trichostema dichotomum	Forked Bluecurls		S1
Trisetum spicatum	Narrow False Oats		S3S4
Utricularia ochroleuca	Yellowish-white Bladderwort		S1
Vaccinium caespitosum	Dwarf Bilberry		S3
Vaccinium ovalifolium	Oval-leaved Bilberry		S1
Vaccinium uliginosum	Alpine Bilberry		S3
Vallisneria Americana	Wild Celery		S2
Veratrum viride	Green False Hellebore		S1
Veronica serpyllifolia ssp. Humifusa	Thyme-Leaved Speedwell		S2S3
Viola nephrophylla	**Northern Bog Violet**		**S2**
Viola sagittata	Arrow-Leaved Violet		S3S4
Viola sagittata var. ovata	Arrow-Leaved Violet		S3S4
Zizia aurea	**Golden Alexanders**		**S1**

Vascular species observed within the Project Area

A total of 294 species of vascular flora have been identified in field assessments. A comprehensive list of species identified is provided in **Appendix I** and discussed in Section 6.7.3.2. No SAR vascular plant species were observed. Five plants are priority species (SOCI), based on provincial status ranks (S3 and S3S4). These SOCI identified within the PA are outlined in Table 6.10-5.

Table 6.10-5 SAR and SOCI vascular flora species observed within the Project Area

Scientific name	Common name	COSEWIC, SARA, NSESA	S-Rank	Habitat on Project Area
Carex wiegandii	Wiegand's Sedge	-	S3	Observed in three locations, all within the mine footprint PA. Within wetlands 12 and 33, and in one upland location between wetlands 48 and 13.
Goodyera repens	Lesser Rattlesnake Plantain	-	S3	Observed in one location on the upland margin of wetland 29, within the mine footprint PA.

Table 6.10-5 SAR and SOCI vascular flora species observed within the Project Area

Scientific name	Common name	COSEWIC, SARA, NSESA	S-Rank	Habitat on Project Area
Listera australis	Southern Twayblade	-	S3	Observed in wetlands 80, 115, 127, 129, 135, 137, 147, and north of 136, all within the haul road PA. Twayblade was typically observed in clumps of 1-5 individuals.
Polypodium appalachianum	Appalachian Polypody	-	S3	Observed immediately adjacent to wetland 137 growing on a boulder within the haul road PA.
Vaccinium corymbosum	Highbush Blueberry	-	S3S4	Observed in one location within wetland 157 within the haul road PA.

6.10.3.2.1 Wiegand's Sedge

Wiegand's sedge (*Carex wiegandii)* was identified in three locations within the mine footprint PA. This species is a member of the Stellulatae section of the genus *Carex*. This species grows in a tuft formation in acidic peatlands, black spruce and larch bogs, and conifer and alder thickets. Within the PA, it was located in two wetlands and one nearby upland area. Wetland 12 is an open treed swamp with mixed canopy coverage and organic soils up to 35 cm deep. The wetland has some disturbance from timber harvesting, resulting in an open canopy. Wetland 33 is a coniferous treed swamp with organic soils exceeding 40 cm depth. This wetland has also experienced some timber harvesting, yet has a relatively diverse vegetation community including *Carex Wiegandii*. The upland habitat in which Wiegand's sedge was identified is a disturbed habitat as well, adjacent to a watercourse which connects wetlands 48 and 13. In Nova Scotia, Wiegand's sedge is considered vulnerable by ACCDC (S3). Wiegand's sedge grows in clumps or clusters of many individual plants. Where C*. wiegandii* was observed, the population consisted of 1-5 clumps of individuals, covering approximately 0.5-1 m^2.

6.10.3.2.2 Lesser Rattlesnake Plantain

Lesser rattlesnake plantain (*Goodyera repens*) is a small, inconspicuous member of the orchid family (Orchidaceae), found in coniferous forests throughout Nova Scotia. Within the PA, two individuals were identified on the upland edge of wetland 29, in a coniferous forest, adjacent to recent timber harvesting. Ground cover was sparse, which is typical habitat for this species. Within Nova Scotia, it is infrequent, but can be numerous where found based on its rhizomatous grown pattern. In Nova Scotia, lesser rattlesnake plantain is considered vulnerable by ACCDC (S3).

6.10.3.2.3 Southern Twayblade

Southern twayblade (*Listera australis*, syn. *Neottia bifolia*) is a small inconspicuous member of the orchid family (Orchidaceae), which has been found in eight locations (wetlands 80, 115, 129, 137, 135, 147, and 161, and in upland habitat north of wetland 136) within the PA. This species belongs to the Atlantic Coastal Plain Flora community and its primary habitat is shaded sphagnum mosses in bogs or coniferous treed swamps. Within the PA, it was typically found in clusters of 5-10 individual plants at the base of small sphagnum hummocks in treed swamps. Its distribution is scattered throughout Nova Scotia and it is considered vulnerable by the ACCDC (S3).

6.10.3.2.4 Appalachian Polypody

Appalachian polypody (*Polypodium appalachianum*) is a member of the Polypody fern family (Polypodiaceae). Its habitat is restricted to cliffs, rocky slopes, bedrock outcrops, and boulders. A population of approximately seven individuals was identified in upland habitat adjacent to wetland 137 (a mixed wood treed swamp) within the haul road PA. The distribution throughout the province is unclear and it is considered vulnerable by the ACCDC (S3).

6.10.3.2.5 Highbush Blueberry

Highbush blueberry (*Vaccinium corymbosum*) is an ericaceous shrub (family Ericaceae) in the Atlantic Coastal Plain Flora community. This species is usually limited to bogs, rock barrens, and lakeshores around Digby and Queens Counties, but it can be found in other locations with remnant populations of Atlantic Coastal Plain Flora. Within the haul road PA, two individuals were identified in wetland 157. This wetland is a treed swamp which is immediately adjacent to Upper Kidney Lake. This species is considered vulnerable to apparently secure by the ACCDC (S3S4).

6.10.3.2.6 Vascular Flora SAR & SOCI Summary

No vascular flora SAR were identified and five vascular plant SOCI were identified within the PA. . Three additional species were identified as having elevated potential to be located within the PA based on habitat preference and known distribution. These species, listed in Table 6.10-5, are redroot (*Lachnanthes caroliniana*, SARA & COSEWIC special concern, NSESA vulnerable), spotted pondweed (*Potamogeton pulcher*, NSESA vulnerable), and black ash (*Fraxinus nigra*, NSESA threatened). The preferred habitats for each of these species were focused on during all vegetation, habitat, and wetland delineation surveys. None of these species were identified within the PA. All priority vascular plant species identified in the PA are shown on Figures 6.10-2 and 6.10-2A to 6.10-2L.

6.10.3.3 Priority Lichen Species

The desktop evaluation for priority species of lichens revealed that boreal felt lichen has been documented within 5 km of the PA in both ACCDC reports (one for the mine footprint and one for the haul road). The boreal felt lichen (*Erioderma pedicellatum*) is listed as endangered by COSEWIC, SARA, and NSESA, and ranked S1S2 by the ACCDC. NSDNR has not determined any lichen species to be ‘location sensitive’. Table 6.10-6 below provides a list of lichen priority species which have elevated potential to be located within the PA, based on habitat preferences and known distribution. No lichen species were documented in the report provided by the NS Museum of Natural History.

Table 6.10-6 Lichen species with elevated potential to be located within the Project Area.

Latin Name	Common Name	SARA, COSEWIC, NSESA	S-Rank
Erioderma mollissimum	Graceful Felt Lichen	SARA, COSEWIC, NSESA Endangered	S1S2
Erioderma pedicellatum (Atlantic pop.)	Boreal Felt Lichen - Atlantic pop.	SARA, COSEWIC, NSESA Endangered	S1S2
Degelia plumbea	Blue Felt Lichen	COSEWIC Special Concern, NSESA Vulnerable	S2
Anzia colpodes	Black-foam Lichen		S3
Cladina stygia	Black-footed Reindeer Lichen		S2S3
Collema furfuraceum	Blistered Tarpaper Lichen		S3
Fuscopannaria leucosticte	Rimmed Shingles Lichen		S1S2
Leptogium corticola	Blistered Jellyskin Lichen		S2S3
Physconia detersa	Bottlebrush Frost Lichen		S2S3
Sticta fuliginosa	Peppered Moon Lichen		S3

Surveys for lichen were completed on February 19, May 2-5, May 8, and 23, 2015 within the mine footprint PA and surrounding Lichen Study Area (LSA) and May 25th and 26th, 2016 within the haul road PA. Six priority lichen species were observed within the broader LSA as described in Section 6.7.3.3. Of the six species, three lichen SAR were observed, as well as three SOCI species, as provided in Table 6.10-7. Of the three SAR identified, two are located within the PA. Blue felt lichen was observed in the mine footprint and haul road PA and in the broader LSA, while frosted glass whiskers was identified within the mine footprint PA. Boreal felt lichen was identified in the LSA, but not within the haul road or mine footprint PA.

Locations where lichen SAR and SOCI species were observed are shown on Figures 6.10-2 and 6.10-2A to 6.10-2L.

Table 6.10-7 SAR and SOCI lichen species observed within the lichen survey area

Common name	*Scientific name*	SARA, COSEWIC, NSESA	S-Rank	Location in the PA
Blistered Jellyskin Lichen	*Leptogium corticola*	-	S2S3	**Mine Footprint PA:** Four individuals observed within the mine footprint PA (east of wetland 29, upland island in wetland 2, on upland edge west of wetland 61, and in wetland 4). One individual observed north of the PA inside LSA.
Blistered Tarpaper Lichen	*Collema nigrescens*	-	S2S3	**Outside Project PA, inside LSA:** Identified in one location northeast of Cameron Flowage, outside the PA, in the LSA.
Blue Felt Lichen	*Degelia plumbea*	SARA and COSEWIC Special Concern, NSESA Vulnerable	S2	**Mine Footprint and Haul Road PA and LSA:** Identified in 26 locations within the haul road PA (1), mine footprint PA (13), and broader LSA (12).
Boreal Felt Lichen	*Erioderma pedicellatum*	Endangered	S1S2	**Outside Project PA, inside LSA:** Identified in three locations to the southwest of the mine footprint PA, in the LSA, within an un-delineated portion of wetland 29.
Frosted Glass-whiskers Lichen	*Sclerophora peronella*	SARA, COSEWIC Special Concern	S1?	**Mine Footprint PA:** Identified in seven locations within the mine footprint PA, adjacent to Wetlands 2 and 29.
Peppered Moon Lichen	*Sticta fuliginosa*	-	S3	**Mine Footprint PA, and LSA:** Two individuals north of wetland 2, 1 in eastern end of wetland 17 within mine footprint PA, 2 additional individuals were observed west of the PA in the LSA.

6.10.3.3.1 Blistered Jellyskin Lichen

Blistered jellyskin lichen *(Leptogium corticola*) was observed in five locations growing on red maple along the edges of wetlands and lacustrine habitats. This species is a foliose lichen belonging to the Collemataceae family. This lichen is found primarily on the base of hardwood trees in moist environments, but occasionally can be found growing on rocks and boulders. Four observations occurred within the mine footprint PA while one was observed outside the PA in the broader LSA. Of the four found in the PA, specimens were observed in wetland 4 and in close proximity to wetland 61 which were both a fen-mixed wood swamp wetland and within the mine footprint. Additional observations occurred on the edges of wetlands 2 and 29, which are both mixed-wood swamp – bog complexes. In Nova Scotia, blistered jellyskin lichen is considered imperiled-vulnerable by ACCDC (S2S3). All observations were associated with the mine footprint and broader LSA; none were observed within the haul road PA.

6.10.3.3.2 Blistered Tarpaper Lichen

Blistered tarpaper lichen (*Collema nigrescens*) was observed at one location spreading over a length of 4 m over a red maple on a slope leading to a lake/clear-cut, approximately 200 m northeast of the northern extent of Cameron Flowage, outside of the PA within the broader LSA. This species is a foliose lichen belonging to the Collemataceae family. This species is typically found growing on the bark of poplar trees and other hardwood trees in mature forests. None were observed within the haul road PA. In Nova Scotia, blistered tarpaper lichen is considered imperiled-vulnerable by ACCDC (S2S3).

6.10.3.3.3 Blue Felt Lichen

Blue felt lichen (*Degelia plumbea*) was observed in twenty-six locations on mature red maple trees in a variety of habitats, including wetland edges, edges of clear-cut, and lacustrine habitat, which were within and in proximity to the PA. This species is typically found in mature hardwood forests in varying moisture regimes. This species is a foliose lichen and a member of the Pannariaceae family.

Of the 26 observations, ten were located within the mine footprint PA and three were located within the haul road PA in intact forests where new road construction will be required. The additional thirteen observations were in the broader LSA surrounding the mine footprint PA. Six observations of this species were documented on the edge of and within wetland 14, which is a swamp-bog-fen wetland complex in the mine footprint. Two separate observations were documented in wetland 17, a tall-shrub swamp – treed bog complex and one population on the edge of wetland 112, a mixed-wood treed swamp within the haul road PA. Another observation was documented growing in upland habitat, 17 m southwest of wetland 61, which is a shrub-fen complex, and an additional observation was documented 5 m south of wetland 29, which is a large swamp-fen-bog complex. Within the haul road PA, this species was documented on mature red maple trees in a mature mixed wood forest 350 and 170 m northwest of wetland 126. This species is listed as special concern by COSEWIC and SARA and vulnerable by NSESA.

6.10.3.3.4 Boreal Felt Lichen

Boreal felt lichen (*Erioderma pedicellatum*) was observed in three locations on mature balsam fir stands on wetland edges outside of the mine footprint PA south of wetland 29 and within the broader LSA (within an un-delineated portion of wetland 29). Typically, this species is found on mature balsam fir stands, but it has been documented on spruce, red maple and birch. Habitat within portions of the PA appeared to be suitable for this species as indicated by two foliose lichen species commonly found in boreal felt lichen habitat which were present throughout the LSA and within the PA. These two foliose lichens were salted shell lichen (*Coccocarpia palmicola*) and texted lungwort (*Lobaria scrobiculata*). However, boreal felt lichen was not observed with the mine footprint or haul road PA. Boreal felt lichen is a red-listed, critically endangered species worldwide. It is listed as endangered by COSEWIC, SARA, and NSESA.

6.10.3.3.5 Frosted Glass-whiskers Lichen

Frosted glass-whiskers lichen (*Sclerophora peronella*) was observed in seven locations on red maple trees primarily in upland habitat, adjacent to wetlands 2 and 29 within the mine footprint PA. This species belongs to the Coniocybaceae family and is a very small (1 mm) fruticose lichen and typically grows in old growth forests with relatively stable humidity levels and usually on the heartwood of hardwood trees. It very rarely grows on bark. Four separate populations were found scattered along the edge of the central inland inclusion within wetland 2. Populations ranged from approximately 10 individual lichens covering less than 0.5 cm^2 to an excess of 200 individuals over an area measuring 240 cm^2. This species was also found west of wetland 2 in upland forests. An additional two observations were documented 20 m east of wetland 29 and 20 m north of the southern wetland/upland boundary of the central upland inclusion in wetland 29. Areas within the mine foot print and haul road PA contained moderately suitable habitat for this species, primarily along the proposed new section of the haul road where more mature hard wood stands with exposed heartwood were found. Despite the presence of suitable habitat within the haul road PA, no specimens were observed. This species is listed as special concern by COSEWIC and SARA.

This species was not identified as having a high likelihood to be present within the PA during the desktop evaluation for rare lichens. This is because it is outside of the previously documented range of this species. According to the Identification and Information Guide to Species at Risk in Nova Scotia (Mersey Tobeatic Research Institute, 2008), Frosted glass whiskers had only been documented in two locations in northwestern Cape Breton Island (Inverness County). This presumed range of this species meant it was excluded from the priority species list, based on known distribution at the time of the desktop review. Since the publication of this Guide, the number of records of this species in Nova Scotia has increased. According to the ACCDC (J. Churchill, Pers. Comm., 2016), this species currently has 30 confirmed records in the database, throughout the province. The Project Team confirmed with the lichen specialist that completed the Beaver Dam surveys that he has submitted another 35 records to ACCDC for inclusion into their database. He also confirmed that this species is largely over looked and under-reported, because of the very small size and cryptic nature of the species.

6.10.3.3.6 Peppered Moon Lichen

Peppered moon lichen (*Sicta Fuliginosa*) was observed primarily on mature red maples near the boundary and within wetland habitat. Two populations were observed within the mine footprint PA and two were observed outside the PA within the broader LSA. Within the PA, *S. fuliginosa* was observed on the boundary of wetland 2 and inside wetland 17. Wetland 2 is a large complex consisting of a treed-bog, graminoid bog, and low shrub bog. Wetland 17 is a complex consisting of a tall-shrub swamp and coniferous treed bog. In Nova Scotia, peppered moon lichen is considered vulnerable by ACCDC (S3). No observations of this species were documented within the haul road PA.

6.10.3.3.7 Lichen SAR & SOCI Summary

While the specific habitat requirements of each of these priority species varies slightly, the common thread between each of these species' habitat requirements is mature to over-mature forests. Stand age is one of the greatest determinants of lichen diversity (McMullin, Duinker, Cameron, Richardson, & Brodo, 2008). Within the mine footprint PA, mature to over-mature stands are infrequent, with the majority of the PA having been harvested for timber production. Mature to over-mature forests within the mine footprint PA that remain are typically associated with large wetland complexes, which are often avoided during timber harvesting. Mature to over-mature forest suitable for rare lichens is present within the haul road PA, primarily where the proposed route involves new construction. No other species of non-vascular flora were identified within the PA.

In total, six priority lichen species were observed during lichen surveys (3 SAR and 3 SOCI). Of the 3 SAR identified, two are located within the PA. Blue Felt lichen was observed in the mine footprint and haul road PA and in the broader LSA, while Frosted Glass Whiskers was identified within the mine footprint PA. Boreal Felt Lichen was identified in the LSA, but not within the haul road or mine footprint PA. The locations of all priority lichen species documented within and adjacent to the PA are provided on Figures 6.10-2 and 6.10-2A to 6.10-2L.

6.10.3.4 Priority Terrestrial Mammal Species

The desktop evaluation for priority species of terrestrial fauna revealed that mainland moose (*Alces alces americanus)* has been documented within 5 km of the PA by the ACCDC. Three records were available for moose within 5 km of the mine footprint PA, while the mainland moose was not documented within 5 km of the haul road PA. Mainland moose are listed as endangered under the NSESA and is provincially ranked S1.

NSDNR has determined that bat hibernacula sites are location sensitive. No bat hibernaculae were documented within 5 km of the PA by the ACCDC. The Project Team reviewed the Recovery Strategy for Little Brown Myotis, Northern Myotis, and Tri-colored Bat in Canada (2015), which confirmed that no known critical habitat (hibernacula) is located in the vicinity of the PA.

Table 6.10-8 below provides a list mammal priority species which have elevated potential to be located within the PA, based on habitat preferences and known distribution. No mammal species were documented in the report provided by the Museum of Natural History.

Table 6.10-8 Mammal species with elevated potential to be identified within the Project Area

Latin Name	Common Name	SARA, COSEWIC, NSESA Status	S Rank
Perimyotis subflavus	Eastern Pipistrelle	Endangered	S1
Lasiurus borealis	Eastern Red Bat		S1
Lasiurus cinereus	Hoary Bat		S1
Myotis lucifugus	Little Brown Myotis	Endangered	S1
Sorex maritimensis	Maritime Shrew		S3
Alces americanus	Moose	Endangered	S1
Myotis septentrionalis	Northern Long-eared Myotis	Endangered	S1
Microtus chrotorrhinus	Rock Vole		S2
Lasionycteris noctivagans	Silver-haired Bat		S1

6.10.3.4.1 Mainland Moose

The mainland moose (*Alces alces americana*) is listed as endangered under NSESA and considered S1, or critically imperiled, by the ACCDC. The moose is the largest member of the deer family (Cervidae), which prefers boreal forest and mixed wood habitats with an abundant food source of young twigs and stems from deciduous trees and shrubs. As a large mammal, they are prone to thermal stress in the summer, often seeking refuge in coniferous forests with full canopy cover. As adept swimmers, they often forage for submerged aquatic vegetation during the summer as well, which provide minerals critical for antler growth. During winter, their long legs and large bodies allow them to move through deep snow, relatively unhindered by cold weather, which may be restrictive to smaller Cervids such as white-tailed deer.

While moose habitat preferences can change as the abundance of available habitat changes (Osko, Hiltz, Hudson, & Wasel, 2004), and habitat selection shows a high degree of variability among individuals (McLaren, Taylor, & Luke, 2009), moose generally require large areas with diverse habitat types (Snaith & Beazley, 2004). Moose habitat preferences are correlated with forage and cover requirements, as well as breeding behaviours (Peek, Urich, & Mackie, 1976). Early successional deciduous vegetation is the main source of moose forage, food types often associated with open or disturbed areas (Snaith, Beazley, MacKinnon, & Duinker, 2002; Snaith & Beazley, 2004; Parker, 2003). The presence of such early successional trees and shrubs is particularly important during the winter months (Parker, 2003). Regenerating vegetation provides good moose browse for 5-40 years following disturbances, such as fire, disease, timber harvest, and wind-throw (Snaith, Beazley, MacKinnon, & Duinker, 2002; Snaith & Beazley, 2004). Fire appears to be the most important disturbance in terms of providing quality moose habitat (Parker, 2003 and references therein). Critical habitat for moose in Alberta was described as open lowlands providing high quality food early in the spring (Hauge & Keith, 1981).

In Nova Scotia, the most important food species are red, sugar, and mountain maple, as well as yellow and white birch (Snaith & Beazley, 2004). In the summer months, particularly in June, aquatic vegetation can be an important component of the diet of moose (Peek, Urich, & Mackie, 1976; Fraser, Arthur, Morton, & Thompson, 1980), but the fact that moose have persisted in areas containing infrequent or unsuitable wetlands suggests that these areas are not essential foraging grounds for moose in Nova Scotia (Snaith & Beazley, 2004). This is supported by the findings of Telfer (1967a) who observed no feeding of moose on aquatic vegetation in the Cobequid region. Water bodies such as streams, ponds, and lake shorelines can be important for relief from heat stress in the summer months (Parker, 2003) because moose are not well adapted for temperatures above 14-20°C (Snaith & Beazley, 2004). Moose have also been shown to preferentially select dense, mature forests with a closed canopy in the summer months (Schwab and Pitt 1991) because the canopy provides shade and heat relief. Dussault et al. (2004) determined that moose showed behavioural adaptations to avoid heat stress in the summer, including using thermal shelters during the day and increasing nocturnal activity.

When female moose give birth to their calves in the spring of the year, they often select islands or peninsulas because of the protection from predators they afford, or areas of high elevation because of visibility in availability of escape routes (Wilton & Garner, 1991). In mountainous regions of British Columbia, however, only 52% of 31 GPS-collared female moose climbed to higher elevations to calve, while the other 48% changed little in elevation (Poole, Serrouya, & Stuart-Smith, 2007).

These researchers found that those females that remained at lower elevations preferentially selected areas with increased forage, decreased slope, and in closer proximity to water. Langley & Pletscher (1994) characterized calving areas in Montana and British Columbia as having dense hiding cover and open patches with bare ground. Cederlund, Sandegren, & Larsson (1987) found that all cows returned to the same summer range each spring, and Bogomolova and Kurochkin (2002) determined that cows returned to the same area of the forest every year before giving birth.

Although not considered critical habitat (Balsom, Ballard, & Whitlaw, 1996), mature, conifer forests are extremely important for moose in Nova Scotia during the late winter months (Telfer, 1967a; Peek, Urich, & Mackie, 1976; Parker, 2003) because they provide protection from extreme weather and the canopy prevents snow from accumulating to depths hindering moose movement (Snaith & Beazley, 2004). Travelling in areas where they sink into the snow can cause moose to expend a significant amount of energy (Lundmark and Ball, 2008) at a time when adequate forage may be scarce. Ideal winter habitat also includes regenerating mixed woods that provide both hardwood and softwood browse (Parker, 2003). In the winter months, moose in northern Nova Scotia concentrate in small areas known as "yards" and move very little (winter range of 2.6 km^2), particularly when the yard is contains good browse as in the Cobequid region (Telfer, 1967a,b). In Quebec, the vast majority of these winter yards were less than 0.5km^2 in area (Guertin, Doucet, & Weary, 1984). Prescott (1968) determined that the use of winter yards by moose in northeastern Nova Scotia was influenced most heavily by having a variety of vegetation types and that food availability was more important than cover in determining the attractiveness of winter habitat to moose (summarized from Parker, 2003). Moose yards in Quebec were characterized by gentle slopes with southern exposure, with pure or mixed stands of black spruce and adjacent patches of white birch, young balsam fir, and alder (Guertin, Doucet, & Weary, 1984). Other important winter food items include willow, which accounted for 35% of the winter diet of moose in northern British Columbia (Goulet, 1985).

A similarly restricted winter range of moose was determined from studies in Minnesota (Ballenberghe and Peek, 1971; Phillips, Berg, & Siniff, 1973). Phillips, Berg, & Siniff (1973) that found that the late winter ranges of all tracked moose were distinct in habitat from the areas used at other time of year and that the summer-fall and early winter ranges were much larger. Furthermore, they determined that most moose returned to the same wintering area each year and that they used similar travel routes each year between seasonal habitats. Geist (1963) suggested that moose return every year to their accustomed summer range. Seasonal movements between winter and summer ranges were reported in moose in Alberta, with individual movement of up to 20 km observed (Hauge & Keith, 1981). Even greater migrations between winter and non-winter ranges of up to 75 km were observed in British Columbia, with non-winter ranges being twice as large as winter ranges (Demarchi, 2003). If the habitat in an area is diverse and provides the necessary interspersion of open areas for foraging and dense, mature forests for cover and relief from snow, seasonal ranges need not be widely separated (Snaith & Beazley, 2004). For example, only 22% and 38% of adult moose in Michigan migrated between distinct summer and winter ranges in 1999 and 2000, respectively. In Alaska, 43% of bulls and cows had distinct winter and summer ranges and distance between ranges were up to 17 km (Bangs, Bailey, & Portner, 1984). In southwestern Nova Scotia, however, the mean home range of moose was found to be large (55.2 km^2) because the rocky, barren conditions mean the moose must range farther to obtain resources (see Snaith & Beazley, 2004). When moving between seasonal ranges, moose use well established routes and travel corridors (Neumann, 2009). In terms of activity within seasons, daily movement rates of moose are higher in the summer than in the winter (McLaren, Taylor, & Luke, 2009).

Two sub-species of moose are present within Nova Scotia. The Cape Breton population (*Alces alces andersoni)* is an introduced species from Alberta and their population is abundant and stable. According to NSDNR (2007), the mainland moose (*Alces alces americana*) population has been reduced to approximately 1200 individuals, restricted to small, isolated sub-populations. The Recovery Plan for Moose in Mainland Nova Scotia (NSDNR, 2007) identifies several limiting factors to moose abundance and distribution. These include disease and parasites, poaching, access to habitat, development, forest practices, acid rain, and climate change. Of highest concern are threats related to disease and parasites, poaching, access to moose habitat, and development.

The primary parasite threatening survival of mainland moose is a parasitic worm (*Parelaphostrongylus tenuis*), known as brainworm. Approximately 65% of white-tailed deer in Nova Scotia are carriers of this parasite; however, it is not lethal to deer. According to NSDNR (2007, p.14), “Where moose and deer range overlap, brainworm is a significant mortality factor”. Because the abundance of white-tailed deer can have an influence on the health of mainland moose, signs of white-tailed deer are documented during mainland moose surveys.

The threats of poaching and access to moose habitat are correlated, as increased access to moose habitat can ultimately increase the level of poaching. These threats can result in lowered viability of individual populations of moose by direct mortality and reduction in range. Similarly, land development of various types can result in increased access to moose habitat, fragmentation of habitat, and direct loss of habitat, while (potentially) further isolating sub-populations from one another.

According to the Recovery Plan for Mainland Moose in Nova Scotia (NSDNR, 2007, p. 30), core habitat means “specific areas of habitat essential for the long-term survivability and recovery of endangered or threatened species and that are designated as core habitat” under the Nova Scotia Endangered Species Act. Mainland moose use a wide variety of habitat types, over relatively large home ranges. The specific spatial and temporal use of the landscape and habitat is not well known in Nova Scotia. As such, ‘core habitat’ has not been defined or designated under the Endangered Species Act. The PA lies within a significant Mainland Moose Concentration Area, as identified in Endangered Mainland Moose Special Management Practices (NSDNR, 2012).

Within the PA, mainland moose tracks were observed within the mine footprint PA in disturbed, roadside habitat north of wetland 56 on May 24th, 2015 during a PGI survey. Moose tracks were observed incidentally outside of the PA to the northwest of the mine footprint PA in two locations on September 9th, 2014. No signs of mainland moose were observed during any survey within the haul road PA.

6.10.3.4.2 Bats

A single abandoned mine opening (AMO) (BED-1-003) was identified as a potential bat hibernaculum. The remaining AMOs when surveyed were either infilled, contained a concrete cap, or were flooded with water, which all limit the potential for bat hibernacula.

The Beaver Dam Gold Mining Company J.H. Austin Main Shaft (BED-1-003) (Hennick et al 2016) is located on the Beaver Dam Road, Halifax County at UTM Zone 20, 522256 east, and 4990298 north. It is located just east of the Beaver Dam Road at the western end of an open historical settling pond (wetland 59) southwest of Cameron Flowage.

The J.H. Austin Main Shaft was originally 67 m deep. It has a concrete collar and cap. The installation date of the collar and concrete cap are unknown, but they have since collapsed and the AMO appears to be filled with rocks. The opening appeared to be less than 5 m deep, with no water observed. The potential for usage of the opening by bats was determined to be very low; however, it could not be visually confirmed because the Project Team could not safely inspect the opening for any internal complexities. A second abandoned mine opening was observed 9 m west of BED-1-003. This opening is described in the NSDNR database as BED-1-002 as an air shaft for the main J.H. Austin Shaft (BED-1-003). This mine opening was clear of debris and backfill and groundwater was observed in BED-1-002 approximately four-meters below the ground surface and one-meter below the top of the mine shaft infrastructure.

As a result of the observed groundwater in the opening nine meters away (BED-1-002), it was hypothesized that groundwater was likely quite close to the surface within BED-1-003 even though it was not observed due to debris and backfill. LiDAR data collected by GHD was used to evaluate the potential of BED-1-003 as a bat hibernaculum. Results derived from LiDAR data (provided on Figure 6.10-3 shows the grade elevation at BED-1-002 (open AMO) to be 134.38 m while the elevation of the BED-1-002 mine shaft opening is 131.43 m. The data also shows the elevation of a pond 40 m downslope of BED-1-002 to be 130.43 m (all elevations are of ±0.15 m accuracy). Based on these elevations and the distance to the pond, the percent grade of the slope on which BED-1-002 and BED-1-003 are located is 9.88%. At this percent slope, the maximum elevation level of the grade at BED-1-003 (located nine-meters from BED-1-002) would be 135.27 m. This would infer that the water is present in BED-1-003 five-meters below (135.27 m minus 130.43 m) the surface, which places it at or just below the location of the debris in the mine shaft. The inferred proximity of water to the top of the mine shaft (approximately five-meters) reduces the potential of BED-1-003 as a bat hibernaculum.

No AMOs were identified along the haul road, although a cluster of 99 AMOs is present approximately 6.4 km southeast of the haul road PA, along the Mooseland Road, within the Mooseland Gold District. A desktop evaluation for potential bat hibernacula was completed within this cluster of AMOs. The Project Team screened out AMOs with opening types of trench and pit, and stope, flooded, infilled, and capped AMOs, and those with an original depth of less than 10 m. According to this desktop review, none of the AMOs reviewed (in the cluster of 99) have the potential to support bat hibernacula. As a result, no bat hibernacula were identified within the mine footprint PA or within the haul road PA. Additionally, no potential bat hibernacula were identified through desktop evaluation within 10 km of the PA.

6.10.3.4.3 Terrestrial Fauna SAR & SOCI Summary

Through all targeted surveys and incidental observations, evidence of a single mammalian priority species was observed. Two sets of mainland moose tracks were observed incidentally to the northwest of the mine footprint PA, outside of the PA in September 2014. One set of moose tracks were observed within the mine footprint PA in May 2015 during a targeted moose survey. No other moose signs (tracks, scat, browse) were observed during targeted moose track surveys or PGI surveys completed within the proposed mine footprint or the haul road PA. Suitable habitat for mainland moose is present within, and adjacent to the PA. No core habitat has been defined for mainland moose in Nova Scotia.

Incidental sightings of mammals were completed during all field programs throughout the PA during all seasons. Aside from mainland moose tracks, no priority mammals or signs thereof were observed. Given the mobility of mammal species, the absence of observation does not confirm absence of the species within the PA. The size of a species and a species' behavior can result in a bias against detection. For instance, very small species such as the maritime shrew (S3) and the rock vole (S2) have been documented within 5 km of the PA, but were not observed by the Project Team within the PA. As another example, the fisher (*Martes pennanti,* S2) is a largely nocturnal hunter, with large home ranges and elusive behavior. They prefer dense, mature to over-mature coniferous stands with large hollow snags for den sites. Their preferred habitat and prey items (porcupine, rabbits, squirrels and other small mammals) are present within the PA. The lack of observed evidence of fisher does not confirm absence of the species.

Determination of the presence of several bat SAR was completed and included both desktop and field components. This evaluation for bat SAR determined that the PA does not contain suitable habitat for bat hibernacula, and no evidence was found that indicates any usage of the PA by priority bat species. No bat hibernaculae are known to be present within a 10 km radius of the PA.

Snapping turtle habitat is present within the PA, and snapping turtles have been incidentally observed along roads in the vicinity of the PA. It is expected that they use habitat within the PA, at least periodically.

6.10.3.5 Priority Herpetofauna Species

A desktop evaluation for amphibian and reptile priority species revealed that no priority herpetile species have been documented within 5 km of the PA (mine footprint and haul road) by the ACCDC. The following herpetofauna priority species have an elevated potential for being located within the PA based on broad geographic range and habitat preferences. No amphibians or reptiles were documented within the vicinity of the PA by the Museum of Natural History.

Table 6.10-9 Herpetofauna priority species with an elevated potential for being identified within the Project Area

Latin Name	Common Name	SARA, COSEWIC, NSESA	S Rank	Habitat
Chelydra serpentina	Snapping Turtle	SARA and COSEWIC Special Concern, NSESA Vulnerable	S3	Southern New Brunswick and parts of mainland Nova Scotia in ponds, lakes, slow-moving streams, and sometimes in brackish water if these water bodies have soft mud bottoms and abundant aquatic vegetation
Glyptemys insculpta	Wood Turtle	SARA, COSEWIC, NSESA Threatened	S2	Lives along permanent streams during much of each year, but in summer may roam widely overland and can be found in a variety of terrestrial habitats adjacent to streams, from deciduous woods, cultivated fields, and woodland bogs, to marshy pastures. Use of woodland bogs and marshy fields is most common in the northern part of the range

Targeted surveys for wood turtles within the mine footprint PA did not reveal any sightings of wood turtles or suitable nesting habitat. No opportunistic observations of wood turtles or suitable nesting habitat were documented during any wetland or watercourse surveys throughout the entirety of the PA.

Snapping turtles have been observed opportunistically along roadsides outside, but within close proximity, of the PA, but not during surveys within the PA. The snapping turtle (*Chelydra serpentina*) is listed as special concern under SARA and COSEWIC (Environment and Climate Change Canada, 2016). Provincially, it is listed as vulnerable under NSESA and ACCDC (S3). Similar to the wood turtle, snapping turtle populations are threatened by low juvenile recruitment and high juvenile mortality. Snapping turtles have a life span of approximately 50 years, however, sexual maturity it not reached until the age of 15-20 years, and survival rates (form embryo through to sexual maturity) are estimated to be as low as 0.1%. According to Environment and Climate Change Canada (2016), the very low juvenile recruitment means that high adult survivability is required to maintain a viable population. As such, a single adult mortality due to natural or anthropogenic factors can be significant to the population.

Snapping turtles can be found in a variety of freshwater ecosystems, such as slow-moving rivers, wetlands, lakes, streams and ponds. Hibernation occurs in freshwater systems deep enough to prevent freezing through during the winter, with a mucky or muddy substrate. They are the most aquatic of freshwater turtles in Nova Scotia, but they do travel through upland habitat and use gravelly areas to nest. The preference for gravelly substrate during nesting is a threat to turtles, as gravid females are attracted to roadsides to nest in the gravelly shoulders of roads. This can result in direct mortality of reproductive females and emerging hatchlings from vehicular collisions. This type of direct mortality, along with direct loss of freshwater and riparian habitats, poses significant threats to the viability of snapping turtle populations in Nova Scotia. Additional threats include an increase in human-subsidized predators such as foxes, coyotes, raccoons, and skunks (Environment and Climate Change Canada, 2016).

Within the PA, no signs of snapping turtles were observed during any field programs. However, snapping turtles were observed opportunistically along roadsides in close proximity of the PA, and as a result of these observations and habitats present within the PA, they are anticipated to use some parts of the PA, at least periodically. Suitable habitat for snapping turtles has been observed in wetlands 8, 10, 17, 29, 59, 61, 66, 68, 69, 159, 168, and 171. These wetlands all provide standing water to a depth exceeding 0.5 m. As such, it is presumed that the open water portions of these wetlands provide overwintering habitat for snapping turtles.

6.10.3.6 Priority Invertebrates

The desktop evaluation for priority species of invertebrate fauna revealed that none were identified within 5 km of the PA by ACCDC reports. NSDNR has not identified any invertebrate species as ‘location sensitive’ species and no invertebrate species were listed as being documented within the vicinity of the PA by the Museum of Natural History. The Maritime Butterfly Atlas was reviewed (Squares 20NQ18, 20NQ28 and 20NQ29) for observations of priority Lepidopterans. A single record of a monarch butterfly was documented within Square 20NQ29. Additionally, Odonata Central (n.d.) was reviewed for records of priority odonates within the vicinity of the PA.

Table 6.10-10 below provides a list of invertebrate fauna priority species which have elevated potential to be located within the PA, based on habitat preferences and known distribution.

Table 6.10-10 Invertebrate priority species with an elevated potential for being identified within the PA

Scientific Name	Common Name	SARA, COSEWIC, NSESA	S Rank	Habitat Preference
Danaus plexippus	Monarch	SARA, COSEWIC, Special Concern	S2B	Almost anywhere during the spring (northward) migration; near the larval food plants during the breeding season; in the fall commonly near the coast, often in large numbers, all heading south. Larvae are found feeding on the following milkweed species: common milkweed and swamp milkweed, neither of which are abundant plants in Nova Scotia. Common milkweed: very common in lower Saint John river valley and possibly north central Nova Scotia.
Gomphus ventricosus	Skillet Clubtail	SARA, COSEWIC Endangered	S1	The larvae inhabit large rivers where they burrow in the soft mud of deep pools.
Alasmidonta undulata	Triangle Floater		S2S3	Frequently found in stream and rivers in sand and gravel substrates.
Amblyscirtes hegon	Pepper and Salt Skipper		S2	Found on the edges of forests and streams. Larvae found feeding on a variety of grass species.
Amblyscirtes vialis	Common Roadside-Skipper		S2	Found in trails, roads in wooded areas, and often near streams. Larvae are found feeding off of a variety of grass species.
Euphydryas phaeton	Baltimore Checkerspot		S3	Found in fresh-water marshes, wet roadsides and meadows. Larvae found feeding on turtlehead and has been reported to feed on beardtongue.

Table 6.10-10 Invertebrate priority species with an elevated potential for being identified within the PA

Scientific Name	Common Name	SARA, COSEWIC, NSESA	S Rank	Habitat Preference
Lethe anthedon	Northern Pearly-Eye		S3	Found in moist woods and dominated by graminoids in the herbaceous layer of forests. Larvae feed off woodland grasses, such as bearded shortgrass and false melic grass.
Pieris oleracea	Mustard White		S2	Found in deciduous woods and bogs. Larvae feed off of various plants belonging to the Brassicaceae (mustard) family.
Polygonia progne	Grey Comma		S3S4	Found in woods and aspen parklands. Larvae found feeding on currants and gooseberries and sometimes elm.
Satyrium liparops	Striped Hairstreak		S3	Found in deciduous forest edges, gardens and roadsides. Larvae found feeding off of members of the Rose family such as plum and cherries. Occurrences with oak, willow, and blueberry.

Surveys for benthic invertebrates were completed as part of the fish habitat assessment, following CABIN protocol methodologies. No priority invertebrate species were identified through sampling for benthic invertebrates (as described in Section 6.6.3.6). Field staff searched for signs of aquatic invertebrates, such as freshwater mussels during all wetland and watercourse related programs. None were observed. According to Fisheries and Oceans Canada (2016b), the brook floater (*Alasmidonta varicosa)* has not been documented in any watersheds within the PA.

The desktop review of damselflies and dragonflies through Odonata Central did not confirm presence of any priority species in the vicinity of the PA nor were any priority species observed during surveys completed within the PA.

A review of data provided by the Maritime Butterfly Atlas confirmed that one monarch butterfly was observed in square 20NQ29. This 10 km x 10 km survey grid covers Mud Lake and Crusher Lake, extending north to Beaver Lake, and east to Smith Lake and Rocky Lake. As the monarch has been recorded in this survey square, it is possible that it uses the mine footprint PA, at least periodically, such as during migration. Monarch butterflies rely on milkweed as a host plant for their larvae; as such, it is a key indicator for presence of the monarch. Surveys for vascular plants were conducted throughout the PA, and staff were instructed to identify any suitable habitat for monarchs based on presence of milkweed. No milkweed was documented during surveys for vascular flora, or opportunistically during any other surveys.

No other targeted surveys were completed for invertebrates; however, no opportunistic observations of priority invertebrate species were recorded. No other priority invertebrate species were identified during the desktop review.

6.10.3.7 Priority Birds

A desktop review for priority species revealed that 33 priority bird species were identified as having the potential to occur within the mine footprint and haul road PA based on habitat availability and geographic distribution (see Table 6.10-11). Eighteen species have been documented within 5 km of the PA by ACCDC. These species are underlined Table 6.10-11.

NSDNR has classified one species, the peregrine falcon, as 'location sensitive', meaning that their exact locations cannot be provided to proponents in ACCDC reports. Instead, ACCDC indicates whether a location sensitive species is documented within 5 km of the PA. The peregrine falcon (*anatum/tundrius* pop.*)* is considered a location sensitive species; however, it has not been documented within 5 km of the PA in either of the ACCDC reports.

A report provided by the Museum of Natural History reported nesting records or probable nesting records for 16 priority species within the vicinity of the PA. These species are highlighted using bold type in the priority bird species list presented in Table 6.10-11.

Table 6.10-11 Priority bird species list

Common Name	Scientific Name	SARA, COSEWIC, NSESA	SRank
Blue-winged Teal	*Anas discors*	-	S3S4B
Common Nighthawk	*Chordeiles minor*	SARA, COSEWIC, NSESA Threatened	S2B
Killdeer	*Charadrius vociferous*	-	S3B
Wilson's Snipe	*Gallinago delicate*	-	S3B
Spotted Sandpiper	*Actitis macularius*	-	S3S4B
Greater Yellowlegs	*Tringa melanoleuca*	-	S3B, S3S4M
American Bittern	*Botaurus lentiginosus*	-	S3S4B
Northern Goshawk	*Accipiter gentilis*	-	S3S4
Black-backed Woodpecker	*Picoides arcticus*	-	S3S4
American Kestrel	*Falco sparverius*	-	S3B
Peregrine Falcon - anatum	*Falco peregrinus pop. 1*	SARA, COSEWIC Special Concern, NSESA Vulnerable	S1B, SNAM
Olive-sided Flycatcher	*Contopus cooperi*	SARA, COSEWIC, NSESA Threatened	S2B
Eastern Wood-Pewee	*Contopus virens*	COSEWIC Special Concern, NSESA Vulnerable	S3S4B
Yellow-bellied Flycatcher	*Empidonax flaviventris*	-	S3S4B
Willow Flycatcher	*Empidonax traillii*	-	S2B

Table 6.10-11 Priority bird species list

Common Name	Scientific Name	SARA, COSEWIC, NSESA	SRank
Eastern Kingbird	*Tyrannus tyrannus*	-	S3B
Philadelphia Vireo	*Vireo philadelphicus*	-	S2?B
Warbling Vireo	*Vireo gilvus*	-	S1B
Gray Jay	*Perisoreus canadensis*	-	S3
Barn Swallow	*Hirundo rustica*	SARA, COSEWIC Threatened, NSESA Endangered	S2S3B
Boreal Chickadee	*Poecile hudsonica*	-	S3
Red-breasted Nuthatch	*Sitta canadensis*	-	S3
Ruby-crowned Kinglet	*Regulus calendula*	-	S3S4B
Eastern Bluebird	*Sialia sialis*	-	S3B
Swainson's Thrush	*Catharus ustulatus*	-	S3S4B
American Robin	*Turdus migratorius*	-	S5B, S3N
Gray Catbird	*Dumetella carolinensis*	-	S3B
Northern Mockingbird	*Mimus polyglottos*	-	S1B
Pine Grosbeak	*Pinicola enucleator*	-	S2S3B, SN5
Purple Finch	*Haemorhous purpureus*	-	S4S5B, S3S4N
Red Crossbill	*Loxia curvirostra*	-	S3S4
Pine Siskin	*Carduelis pinus*	-	S2S3
Evening Grosbeak	*Coccothraustes vespertinus*	-	S3S4B, S3N
Tennessee Warbler	*Vermivora peregrine*	-	S3S4B
Cape May Warbler	*Dendroica tigrina*	-	S2B
Bay-breasted Warbler	*Dendroica castanea*	-	S3S4B
Canada Warbler	*Wilsonia canadensis*	SARA, COSEWIC Threatened, NSESA Endangered	S3B
Wilson's Warbler	*Wilsonia pusilla*	-	S3B
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	-	S2S3B
Rusty Blackbird	*Euphagus carolinus*	SARA, COSEWIC Special Concern, NSESA Endangered	S2B
Baltimore Oriole	*Icterus galbula*	-	S2S3B

6.10.3.7.1 Bird species observed within the Project Area

During field assessments within the PA, a total of 25 priority bird species, 17 SOCI and eight SAR, were observed. These species are presented in Table 6.10-12.

An additional five species considered SOCI in the breeding season (i.e., ACCDC only ranks these species with a breeding status S-rank) were observed within the PA only during migration periods:

common goldeneye, American coot, American kestrel, brown-headed cowbird, and pine grosbeak. Though not observed during the breeding season, the desktop review for priority species found that the Wilson's warbler and pine grosbeak (*Pinicola enucleator*) could be present within the PA during breeding season based on habitat availability and geographic distribution. The remaining three species are not likely to breed within the PA. One pine grosbeak was observed incidentally within the haul road PA, also during spring migration.

Table 6.10-12 Priority bird species observed within the PA

Common name	SARA	COSEWIC	NSESA	S-Rank*	Season observed**	Number in Mine Footprint PA								Number in Haul Road PA						All PA
						Spring migration		Breeding		Fall migration		Total in Mine Footprint PA		Spring migration		Breeding		Total in Haul Road PA		Total
						#	Location	#	Location	#	Location	#	Location	#	Location	#	Location	#	Location	
Barn Swallow	-	T	E	S2S3B	SM	.	.	.	.	.	.	0		1	8	.	.	**1**	**8**	**1**
Canada Warbler	T	T	E	S3B	SM, B, B-I	.	.	2	33, Inc.	.	.	**2**	**33, Inc.**	10	2, 4, 6, 10, 28, 35, 39, 41, 45	4	16, 25	**14**	**2, 4, 6, 10, 16, 25, 28, 35, 39, 41, 45**	**16**
Chimney Swift	T	T	E	S2B, S1M	B-I	.	.	2	23	.	.	**2**	**23**	.	.	.	.	**0**	**.**	**2**
Common Nighthawk	T	T	T	S2B	B	.	.	.	.	.	.	**0**		.	.	4	26, CONI1, CONI9	**4**	**26, CONI1, CONI9**	**4**
Olive-sided Flycatcher	T	T	T	S2B	B, B-I	.	.	5	3, 22, Inc.	.	.	**5**	**3, 22**	.	.	5	5, 29, 30, 43	**5**	**5, 29, 30, 43**	**10**
Eastern Wood Pewee	-	SC	V	S3S4B	B-1	.	.	1	Inc.	.	.	**1**	**Inc.**	.	.	1	Inc.	**1**	**Inc.**	**2**
Peregrine Falcon	SC	SC	V	S1B	FM, FM-I	.	.	.	.	2	9, 10	**2**	**9, 10**	.	.	.	.	**0**	**.**	**2**
Rusty Blackbird	SC	SC	E	S2B	FM-I	.	.	.	.	1	15	**1**	**15**	.	.	.	.	**0**	**.**	**1**
Bay-breasted Warbler	-	-	-	S3S4B	B	.	.	.	.	.	.	**0**		NPS	NPS	2	30, 31	**2**	**30, 31**	**2**
Black-backed Woodpecker	-	-	-	S3S4	SM, B, B-I	.	.	.	.	.	.	**0**		3	19, 29	3	18, 22, 39	**6**	**18, 19, 22, 29, 39**	**6**
Blackpoll Warbler***	-	-	-	S3S4B	B	.	.	.	.	NPS	NPS	**0**		NPS	NPS	11	1, 2, 5, 24, 33, 36, 38	**11**	**1, 2, 5, 24, 33, 36, 38**	**11**
Boreal Chickadee	-	-	-	S3	SM, SM-I, B-I	4	30	2	Inc.	14	14, 21, 23, 25, 26, 30, 31, CPC3, Inc.	**20**	**14, 21, 23, 25, 26, 30, 31, CPC3**	4	20, 23, 35	1	Inc.	**5**	**4, 20, 23, 25, Inc.**	**25**
Gray Catbird	-	-	-	S3B	B	.	.	.	.	.	.	**0**		.	.	1	11	**1**	**11**	**1**
Gray Jay	-	-	-	S3	SM, SM-I, B, FM	.	.	1	22	44	2, 3, 4, 5, 6, 7, 11, 13, 15, 16, 17, 18, 21, 24, 25, 26, 27, 28, 29, 30, 31, CPC1, CPC2	**45**	**2, 3, 4, 5, 6, 7, 11, 13, 15, 16, 17, 18, 21, 22, 24, 25, 26, 27, 28, 29, 30, 31, CPC1, CPC2**	20	4, 5, 12, 18, 27, 28, 29, 32, 39, 44	.	.	**20**	**4, 5, 12, 18, 20, 27, 28, 29, 32, 39, 44**	**65**

Greater Yellowlegs	-	-	-	S3B, S3S4M	SM, B, B-I	29	1, 2, 4, 5, 6, 7, 24, 25, 28, 30, 31	6	1, 3, 10, 26, Inc.	.	.	**35**	**1, 2, 34, 5, 6, 7, 10, 24, 25, 26, 28, 30, 31**	3	1, 3, 4	5	1, 3	**8**	**1, 3, 4**	**43**
Northern Goshawk	-	NAR	-	S3S4	SM	.	.	.	.	.	.	**0**		1	1	.	.	**1**	**1**	**1**
Northern Harrier	-	-	-	S3S4B	SM, B	1	MR-1	2	10, Inc.	.	10, MR-1, Inc	**3**	**10**	.	.	.	.	**0**	**.**	**3**
Pine Siskin	-	-	-	S2S3	FM, I-FM	.	.	.	.	119	2, 3, 5, 17, 22, 24, 26, 30, 32, CPC2	**119**	**2, 3, 5, 17, 22, 24, 26, 30, 32, CPC2**	1	7	.	.	**1**	**7**	**120**
Red Crossbill	-	-	-	S3S4	SM-I	.	.	.	.	.	.	**0**		3	22	.	.	**3**	**22**	**3**
Red-breasted Nuthatch	-	-	-	S3	SM, SM-I, B, B-I	3	6, 31	.	.	1	25	**4**	**6, 25, 31**	8	2, 7, 12, 18, 19, 29, 30, 40	24	5, 8, 18, 19, 21, 22, 25, 33, 35, 37, 43, 44, 45, 46, 50	**32**	**2, 5, 7, 8, 12, 18, 19, 21, 22, 25, 29, 30, 33, 35, 37, 40, 43, 44, 45, 46, 50**	**36**
Ruby-crowned Kinglet***	-	-	-	S3S4B	B	NPS	NPS	14	4, 7, 10, 16, 21, 25, 26, 29, 30, 31	NPS	NPS	**14**	**4, 7, 10, 16, 21, 25, 26, 29, 30, 31**	NPS	NPS	82	2, 4, 6, 7, 10, 11, 18, 21, 23, 24, 25, 26, 27, 29, 34, 35, 36, 38, 39, 40, 41, 42, 43, 47, 48, 49	**82**	**2, 4, 6, 7, 10, 11, 18, 21, 23, 24, 25, 26, 27, 29, 34, 35, 36, 38, 39, 40, 41, 42, 43, 47, 48, 49**	**96**
Swainson's Thrush***	-	-	-	S3S4B	B, B-I	NPS	NPS	20	1, 3, 10, 17, 24, 25, 26, 27, 28, 29, 30, 31, 32	.	.	**20**	**1, 3, 10, 17, 24, 25, 26, 27, 28, 29, 30, 31, 32**	NPS	NPS	34	1, 2, 4, 6, 8, 9, 18, 22, 24, 26, 29, 39, 40, 42, 45	**34**	**1, 2, 4, 6, 8, 9, 18, 22, 24, 26, 29, 39, 40, 42, 45**	**54**
Tennessee Warbler	-	-	-	S3S4B	B	.	.	1	25	.	.	**1**	**25**	.	.		.	**0**	**.**	**1**
Wilson's Snipe***	-	-	-	S3B	B, I-B	NPS	NPS	3	2, 16, 30	.	.	**3**	**2, 16, 30**	NPS	NPS	.	.	**0**	**.**	**3**
Yellow-bellied Flycatcher***	-	-	-	S3S4B	B, B-I	NPS	NPS	8	16, 17, 23, 28, 29, 30	.	.	**8**	**16, 17, 23, 28, 29, 30**	NPS	NPS	39	18, 20, 22, 23, 27, 28, 29, 32, 33, 35, 36, 40, 42, 44, 45, 46, 47, 49, 50	**39**	**18, 20, 22, 23, 2, 28, 29, 32, 33, 35, 36, 40, 42, 44, 45, 46, 47, 49, 50**	**47**
Totals						**37**		**67**		**181**		**285**		**54**		**216**		**27 0**		**555**

Notes: SC=Special Concern, T=Threatened, E= Endangered and V=Vulnerable. SM=Spring Migration, B=Breeding, FM=Fall Migration, I-B= Observed incidentally during breeding, I-FM= Observed incidentally during fall migration and I-SM=Observed incidentally during spring migration. The ACCDC works with provincial and federal experts to develop rarity ranks (i.e. S-ranks) for species in Nova Scotia, as well as the other maritime provinces, see http://www.accdc.com/en/rank-definitions.html for more information. Crusher Point Counts (**CPC**) waypoints were part of the mine footprint PA in Fall 2014, but that area of the mine footprint PA was removed following that season due to changes in the design of the Project footprint. Therefore data from these point counts were not included in analyses of results for the dedicated surveys, but priority species are included here as incidental observations. **NPS** Indicates that the species was observed in that season, but based on breeding status; it is not a priority species during that season. **Inc**. indicates that the species was observed incidentally, i.e. outside of a designated point count location.

All priority species observed in the PA (SAR and SOCI) have been described individually in sub-sections for other taxa in this chapter (fish, flora, and terrestrial fauna). Given the abundance of priority bird species observed, SOCI are only described in tabular form above, which identifies the location, abundance, and seasonality of observations. The eight bird SAR observed in the PA are described in further detail below.

6.10.3.7.2 Common Nighthawk

The common nighthawk is a medium-sized bird, with large eyes, a small bill, and a large mouth on its large flattened head. They have long slender pointed wings and a long slightly notched tail. Preferred breeding habitats include areas devoid of vegetation, such as sand dunes, beaches, logged areas, burned-over areas, forest clearings, peat bogs, and pastures. Common nighthawks were not detected during the dedicated species surveys completed within the mine footprint PA in 2015; however, preferred breeding habitat, specifically logged areas, peat bogs and forest clearings, were observed within the mine footprint PA.

Suitable breeding habitats were observed within the haul road PA and four common nighthawks were observed during both breeding bird (n=1) and dedicated species surveys (n=3) in 2016. Common nighthawks were observed within the haul road PA, in habitats with expansive gravelly areas adjacent to clear cuts or disturbed areas (Haul Road PC26, CONI1, and CONI9). There were no signs of breeding evidence (e.g., booming display) observed, but breeding is still possible as these birds were observed near suitable nesting habitat, specifically clear cuts and gravel on expanded roadsides. Common nighthawk populations have been on the decline; however, the reasons for the decline have not been determined. Large-scale pesticide use, which has reduced the numbers of insect prey, is a likely factor for the decline in common nighthawk populations (COSEWIC, 2007a). Habitat loss and alteration, including fire suppression and intensive agriculture, may also have contributed to these declines (COSEWIC, 2007a). The common nighthawk is federally listed as threatened by COSEWIC and SARA, provincially listed as threatened by NSESA, and the breeding population in Nova Scotia is ranked as Imperiled (i.e., S-rank S2B) by ACCDC.

6.10.3.7.3 Peregrine Falcon

The peregrine falcon is a medium to large falcon with long, pointed wings. Peregrine falcons use a wide variety of habitats, including Arctic tundra, sea coasts, prairies, and urban centers. They nest on cliff ledges, in crevices, and near bridges. Suitable breeding habitat was not present within the mine footprint or haul road PA. Two peregrine falcons were observed incidentally (n=1) and during the dedicated fall migration surveys (n=1) adjacent to the mine footprint PA, in 2014. Both observations were documented immediately north of the Mine Footprint PA, between Mud Lake and Cameron Flowage. The peregrine falcon populations have seen a decline due to exposure to organochlorine pesticides, particularly DDT, causing reproductive failure (these compounds continue to be used in parts of the wintering range of Anatum and Tundrius peregrine falcons; COSEWIC, 2007b). Human disturbance at nest sites, including illegal harvest of eggs and nestlings also contribute to a decline in the populations (COSEWIC, 2007b). The peregrine falcon is federally listed as special concern under COSEWIC and SARA, provincially listed as vulnerable under NSESA, and the breeding population in Nova Scotia is ranked as critically imperiled (i.e., S-rank S1B) by the ACCDC.

6.10.3.7.4 Chimney Swift

The chimney swift is often mistaken for a swallow; however, it is easily distinguished by its cigar-shaped body, short tail, and long narrow pointed wings. Chimney swifts mainly use chimneys for nesting and roosting, since hollow trees in old growth forests have become rare, however, they will also nest in other artificial sites with vertical surfaces and low light (including air vents, old wells, abandoned cisterns, outhouses, boathouses, garages, silos, barns, lighthouses, and firewood sheds; Cornell Lab of Ornithology, n.d.). They are aerial foragers and are often found near water where insects are abundant. No suitable chimneys for roosting and nesting were observed within the PA; however, waterbodies used for foraging are present within the mine footprint and the haul road PA. Two chimney swifts were observed incidentally during the breeding season in 2015, within the mine footprint PA (Figure 6-10-2). They were observed from wetland 53, which is in the center of the mine footprint PA, south of Crusher Lake. There were no signs observed of chimney swifts breeding.

The main cause for the decline of the chimney swift is unknown; however, factors such as a decrease in insect prey due to pesticides and habitat loss are likely involved in the decline (COSEWIC, 2007c). The chimney swift is federally listed as threatened under COSEWIC and SARA, provincially listed as endangered under NSESA, and the breeding population in Nova Scotia is ranked as imperiled (i.e., S2B), whereas the aggregating transient population is ranked as critically imperiled by the ACCDC (i.e., S-rank SM1).

6.10.3.7.5 Olive-sided Flycatcher

The olive-sided flycatcher is a medium-sized songbird, with deep brown olive-gray on the sides and flanks. Suitable habitat for the olive-sided flycatcher includes open areas with tall trees or snags, forest openings, forest edges near natural openings, or human-made openings. Suitable habitat also includes coniferous or mixed coniferous forests, likely near wetland areas. Suitable habitat, including logged areas and forest edges near natural and human-made openings, are present within the mine footprint and haul road PA. No evidence of breeding was observed, however, 10 males were heard singing within the PA, during the 2015 breeding bird surveys within the mine footprint PA, and incidentally within the haul road PA in 2016, suggesting possible breeding within the associated habitats (Figure 6.10-2A). Olive-sided flycatcher observations were sparse, yet scattered across the mine footprint and haul road PA. This species was documented near wetland boundaries, typically with disturbed habitats nearby.

The decrease in the population of olive-sided flycatchers is puzzling due to its preference for sparse canopy cover; it may respond positively to forest management practices, such as timber harvesting. A contributing factor to the population declines may be due to habitat alteration and loss in migration stop-over and wintering grounds (Cornell Lab of Ornithology, n.d.b). The olive-sided flycatcher is federally listed as threatened under COSEWIC and SARA, provincially listed as threatened under NSESA, and the breeding population in Nova Scotia is ranked as imperiled (i.e., S-rank S2B) by ACCDC.

6.10.3.7.6 Canada Warbler

The Canada warbler is a small brightly coloured songbird; the males have blue-gray upperparts and tail with a contrasting yellow throat and breast. The Canada warbler has a wide range of suitable habitats, including deciduous, coniferous, and mixed forests, with a well-developed shrub layer. Their preferred habitat is moist mixed forests (COSEWIC, 2008). They also use regenerating stands after natural and human-caused disturbances (COSEWIC, 2008). The Canada warbler's preferred habitat, moist mixed forests, was observed within the mine footprint PA as well as within the haul road PA. Regenerating forest stands and mixed, coniferous, and deciduous forests are predominant on the landscape within the PA. Sixteen Canada warblers were observed during the 2015 and 2016 breeding bird surveys within the PA. Within the mine footprint PA, probable breeding behavior (i.e., agitated behavior and anxiety calls of an adult) was observed by one Canada warbler and possible breeding was exhibited by singing males during breeding season. Observation of this species in the same location in two subsequent breeding bird surveys within the haul road PA indicates that it may have established a territory, which is evidence of probable breeding.

The factors for population decline of the Canada Warbler are unknown. One likely reason is habitat degradation and loss of wintering ranges. Habitat loss includes agricultural activities and road development and conversion of swamp forests (COSEWIC, 2008). The Canada warbler is federally listed as threatened under COSEWIC and SARA, provincially listed as endangered under NSESA, and the breeding population in Nova Scotia is ranked as vulnerable (i.e., S-rank S3B) by ACCDC.

6.10.3.7.7 Rusty Blackbird

The rusty blackbird is a medium-sized songbird with pale yellow eyes, a black slightly curved bill, and a slightly rounded tail. Rusty blackbird breeding habitat is forested wetlands, including peat bogs, sedge meadows, marshes, swamp, beaver ponds, slow moving streams, and pasture edges. One rusty blackbird was observed incidentally within the mine footprint PA during the 2014 fall migration survey in a large wetland complex to the northwest of the mine footprint PA (PC15). Breeding habitat, including forested wetlands, swamps, and peat bogs are present within the mine footprint and haul road PA, however, no evidence of breeding was observed (no birds were observed in haul road PA).

The biggest threat to the rusty blackbird is degradation of the primary wintering range in the Mississippi Valley (i.e., conversion of flood plain forests to agricultural land and urban zones; COSEWIC, 2006). The rusty blackbird is federally listed as special concern under COSEWIC and SARA, provincially listed as endangered under NSESA, and the breeding population in Nova Scotia is ranked as imperiled (i.e., S2B) by ACCDC.

6.10.3.7.8 Barn Swallow

The barn swallow is a medium-sized songbird, which is easily distinguishable by the steely-blue upperparts and cinnamon underparts, chestnut throat and forehead, and the deeply forked tail. Caves, holes, crevices, and ledges in cliff faces were the most common nesting habitats of barn swallows prior to European colonization; however, they have since shifted to nesting in and on artificial structures (e.g., barns and other outbuildings, garages, houses, bridges and road culverts; COSEWIC, 2011). Nesting habitat is available within the mine footprint PA and the haul road PA, particularly artificial structures including a cabin, bridges, and road culverts. One barn swallow was observed within the haul road PA during the 2016 spring migration surveys, near wetland 159, between Highway 224 and the mine footprint PA, shown on Figures 6.10-1 A-L. None were observed during the breeding bird surveys completed in the PA.

The main contributing factors in the decline of barn swallow populations are the loss of nesting and foraging habitats, the decline of insect prey populations, and direct and indirect mortality due to climate perturbation on breeding grounds. The barn swallow is federally listed as threatened under COSEWIC, provincially listed as endangered under NSESA, and the breeding population in Nova Scotia is range ranked as imperiled to vulnerable (i.e., S-rank S2S3B) by ACCDC.

6.10.3.7.9 Eastern Wood-Pewee

The eastern wood-pewee is a small forest bird with grayish-olive upperparts and pale underparts. Mature and intermediate-age deciduous and mixed forests with an open understory are the preferred breeding habitats of the eastern wood-pewee in Canada (COSEWIC, 2012). This species is also typically associated with forest clearings and edges within the vicinity of its nest (COSEWIC, 2012). Suitable breeding habitat (as previously described) is available for the eastern wood-pewee within the mine footprint and haul road PA. Two eastern wood-pewees were incidentally observed within the PA during the breeding season in 2016. One was identified at the outlet of Cameron Flowage, to the east of the mine footprint PA, while the second was observed incidentally within the haul road PA, east of wetland 114. No breeding evidence was observed, although suitable habitat is present within the PA. As such, it is identified as a possible breeder.

The factors related to the decline of the eastern wood-pewee are largely unknown. Loss and degradation of habitat on the breeding and wintering grounds due to changes of forest management and urban development are possible contributing factors (COSEWIC, 2012). Other possible factors are the decrease of insect prey populations and high mortality on wintering grounds and while migrating and high rates of nest predation form avian predators (COSEWIC, 2012). The eastern wood-pewee is federally listed as special concern under COSEWIC, provincially listed as vulnerable under NSESA, and the breeding population in Nova Scotia is range ranked as vulnerable to apparently secure (i.e., S3S4B) by ACCDC.

6.10.3.7.10 Bird SAR & SOCI Summary

Twenty-five priority species were identified within the PA, of which 17 are SOCI and eight are SAR. A total of 555 individual priority birds were observed throughout the field programs. All bird SAR anticipated to be within the PA were observed. Five SOCI were observed that were not anticipated within the PA. Nineteen priority species that were anticipated to be observed within the PA were not observed throughout the various surveys or incidentally inside the season in which they are determined to be priority species (e.g., spotted sandpiper was observed during spring migration; however its rarity rank of S3 applies to the breeding population). Given the mobility of bird species, the absence of observation does not confirm absence of the species within the PA. The northern harrier (S3S4B) was observed, but was not anticipated to be observed within the PA. Their preferred habitat consists of open habitats ranging from the Arctic tundra to the prairie grasslands and fields. The northern harrier was not anticipated due to their preferred habitat, prairie grasslands and fields, not being present within the PA. The chimney swift (threatened under SARA & COSEWIC, endangered under NSESA, S2B, S1M) was observed within the PA, but was not anticipated to be within the PA. Their preferred breeding habitat, chimneys or old cabins, was not expected to be present within the PA, however, one outbuilding is present. One of the anticipated species that was absent is the killdeer (*Charadrius vociferous*; S3B). Their preferred habitat includes forested clear-cut areas. These forested clear cut areas were observed within the mine footprint and haul road PA, however, no killdeer were observed within the PA. Another anticipated species to be present within the PA is the rose-breasted grosbeak (*Pheucticus ludovicianus*; S2S3B). They use a wide variety of habitats including deciduous and mixed wood uplands and lowlands. The rose-breasted grosbeak's habitat, deciduous and mixed wood uplands, is present within the PA, however, no rose-breasted grosbeaks were observed.

During all breeding bird surveys, evidence of breeding behavior was recorded for all species, with particular attention towards SAR and SOCI. Breeding evidence was recorded in accordance with guidance provided by Bird Studies Canada (2016), which defines behavior in terms of possible, probable, and confirmed breeders. Any species observed during breeding season singing in suitable habitat is identified as a possible breeder. Signs of probable breeding observed are agitation and established territories. Evidence of confirmed breeders observed includes distraction displays, feeding young or carrying food, nests with young, or recently fledged young. The highest evidence of breeding status recorded for all priority bird species observed during breeding season is presented in Table 6.10-13. Three SAR are identified as possible breeders, while one (Canada warbler) was documented as a probable breeder. Eight SOCI are identified as possible breeders, while four show evidence of probable breeding. One species (Swainson's thrush) was confirmed to be breeding in the mine footprint PA. It was observed carrying food near PC 32 (along the western shore of Cameron Flowage).

Table 6.10-13 Highest breeding evidence recorded for avian SAR and SOCI within each portion of the PA

Species Code	Common Name	SARA, COSEWIC, NSESA Ranking	Srank	Mine Footprint	Haul Road
CONI	Common Nighthawk	SARA, COSEWIC, NSESA Threatened	S2B	.	Possible
OSFL	Olive-sided Flycatcher	SARA, COSEWIC, NSESA Threatened	S2B	Possible	Possible
CAWA	Canada Warbler	SARA, COSEWIC Threatened, NSESA Endangered	S3B	Probable	Probable
EAWP	Eastern Wood Pewee	COSEWIC Special Concern, NSESA Vulnerable	S3S4B	Possible	Possible
BBWA	Bay-breasted Warbler		S3S4B	.	Possible
BBWO	Black-backed Woodpecker		S3S4	.	Possible
BPWA	Blackpoll Warbler		S3S4B	.	Possible
GRCA	Gray Catbird		S3B	.	Possible
GRJA	Gray Jay		S3	Possible	.
GRYE	Greater Yellowlegs		S3B, S3S4M	Probable	Probable
NOHA	Northern Harrier		S3S4B	Possible	Possible

Table 6.10-13 Highest breeding evidence recorded for avian SAR and SOCI within each portion of the PA

Species Code	Common Name	SARA, COSEWIC, NSESA Ranking	Srank	Mine Footprint	Haul Road
RBNU	Red-breasted Nuthatch		S3	.	Probable
RCKI	Ruby-crowned Kinglet		S3S4B	Probable	Probable
SWTH	Swainson's Thrush		S3S4B	Confirmed	Probable
TEWA	Tennessee Warbler		S3S4B	Possible	.
WISN	Wilson's Snipe		S3B	Possible	.
YBFL	Yellow-bellied Flycatcher		S3S4B	Probable	Probable

The location of all priority birds observed is provided on Figures 6.10-2 and 6.10-2 A to L.

6.10.4 Consideration of Consultation and Engagement Results

Key issues raised during public consultation and Mi'kmaq engagement relating to SAR and SOCI include potential direct effects on rare flora and fauna associated with construction of the Beaver Dam Mine site and haul road and potential indirect effects associated with changes to other VCs, such as wetlands, surface water and groundwater. Potential effects on traditional uses of land and resources by the Mi'kmaq were noted, including SAR/SOCI species of significance to the Mi'kmaq such as moose and American Eel.

The results of the public consultation and Mi'kmaq engagement have been considered in the environmental effects assessment, including the Proponent's commitments on mitigation and monitoring measures and proposed compliance and effects monitoring programs, as well as the Proponent's broader commitment to ongoing public consultation and Mi'kmaq engagement. Specific to evaluating the effect on SAR and SOCI, these are found within the following environmental effects assessment.

6.10.5 Effects Assessment Methodology

6.10.5.1 Boundaries

Spatial Boundaries

The spatial boundaries used for the assessment of effects for all SAR and SOCI include the mine footprint and the haul road PA. The LAA consists of any habitat contiguous and consistent with habitat available within the PA upon which SAR or SOCI rely (i.e., critical habitat, if critical habitat is identified). Further guidance on inclusion of LAA within the effects assessment process is specific to each taxa and is provided herein:

- Fish: LAA is the watercourse and any contiguous upstream watercourses, waterbodies, and wetlands connected by obvious surface flow;
- Vascular Flora and Lichens: LAA is the habitat which is contiguous and consistent with the habitat in which the species is located, up to and including the entire forest stand;

- Terrestrial Fauna: LAA is habitat consistent with and contiguous with habitat available within the PA, plus a 1bkm buffer (based on the recommended buffer for determining risks to bat SAR, identified above); and,
- Birds: LAA is habitat consistent with and contiguous within habitat within the PA, plus a 1bkm buffer. In this case, the 1 km buffer is based on breeding territory and home range for most priority bird species identified within the PA.

These spatial boundaries (PA plus LAA) will help to identify the direct or indirect impacts to SAR and SOCI and the effects of the Project on distribution and abundance of these species.

Temporal Boundaries

The temporal boundaries used for the assessment of effects to SAR and SOCI are the construction phase, operational phase, and decommissioning and reclamation phases.

Technical Boundaries

No technical boundaries were identified for the effects assessment of SAR and SOCI.

Administrative Boundaries

The primary administrative boundaries for SAR and SOCI are outlined in the federal SARA and provincial NSESA. Terrestrial fauna are provided protection under the provincial Wildlife Act and the federal Canada Wildlife Act. Fish species are further regulated under the federal Fisheries Act, while migratory bird species are regulated under the Migratory birds Convention Act.

6.10.5.2 Thresholds for Determination of Significance

A significant adverse effect from the Project on SAR and SOCI is defined as an effect that is likely to cause a permanent alteration to a species' distribution or abundance, or alteration of critical habitat. An adverse effect that does not cause a permanent alteration in distribution or abundance of terrestrial fauna species is considered to be not significant. Sedentary species such as vascular and non-vascular flora do not have the opportunity to move to avoid direct or indirect impact. For these species, the loss of a population of species that is important in the context of the province, or that species' overall abundance or distribution, is considered significant. Mortality of a single SAR could, under some circumstances, be considered a significant effect.

6.10.6 Project Activities and Species of Conservation Interest and Species at Risk Interactions and Effects

Priority species identified within the PA represent a diversity of taxa, habitat preferences, and, therefore, represent a diversity of potential and confirmed Project interactions, effects, mitigation, and monitoring. As such, Project effects, mitigation, and monitoring are discussed in terms of each taxa, rather than individual species, with a focus on SAR, recognizing that mitigation measures for SAR will generally provide appropriate mitigation for identified SOCI in the same taxonomic group. Where this is not the case, it will be stated. Project interactions, mitigation, and monitoring for each broad taxonomic group are outlined in previous chapters as well, and these mitigation measures are appropriate and should be applied for all SAR and SOCI within the same taxonomic group.

6.10.6.1 Priority Fish Species

Three priority fish species have been identified or are expected to reside within watercourses in the PA (American eel, Atlantic salmon, and Blacknose dace). American eel and Atlantic salmon have been included in the effects assessment section of this EIS. Although these species are not listed under provincial or federal endangered species legislation, DFO has indicated that they are currently being reviewed for protection under SARA, and it would be prudent for the Project Team to plan for these species as if they were protected under this legislation. Fish habitat is described in Section 6.6 using Atlantic salmon habitat as the reference species. Atlantic salmon are sensitive to changes in their aquatic ecosystem, and they have specific habitat requirements, while American eel and black-nose dace are considered to be habitat generalists. As such, standard mitigation and monitoring for fish and fish habitat (Section 6.6.7) will address direct and indirect effects to Atlantic salmon, Blacknose dace, and American eel.

Atlantic salmon is documented by the Nova Scotia Salmon Association to be present within the Killag River (near the mine footprint PA) and the West River Sheet Harbour (haul road PA), and it is presumed that they also use tributaries to these watercourses, at least periodically. None of the watercourses within the mine footprint have been identified as Type 1 salmon habitat (good salmonid spawning and rearing habitat; often with some feeding pools for larger age classes). All watercourses within the mine footprint PA are first order streams and provide limited quality fish habitat, with the exception of watercourse 5 downstream of Crusher Lake, which has been determined to provide Type II habitat for Atlantic salmon, and migration, juvenile, and overwintering habitat for American eel. Direct impacts to this watercourse are not anticipated to support mine development. As such, the direct loss of quality habitat for Atlantic salmon is anticipated to be low within the mine footprint PA.

Within the haul road PA, there are twenty-four watercourses defined as Type 1 or 2 salmon habitat. American eel were confirmed in three watercourses (watercourses N, V and AH). Thirty-one watercourses within the haul road PA are determined to provide potential migration, juvenile rearing, and/or overwintering habitat for American eel. Proposed Project development at these watercourse locations includes the upgrade of the existing haul road, including widening and straightening activities, and installation of new culverts and ditch systems to support upgrading and new construction where necessary. These Project interactions can be minimized with the implementation of standard mitigation practices for installation of culverts in fish bearing streams (Nova Scotia Environment, 2015b) and in many cases will result in improved fish passage based on condition of current culvert installation along the existing logging road. Construction of a 4 km section of new road is expected to involve one watercourse crossing (WC O). Watercourse O provides juvenile rearing habitat for American eel and WC-O provides eel migration habitat. Other crossings may be required, once detailed design of this section of new road is completed. Standard approvals and mitigation will be required for all watercourse crossings, including those in involving new road construction.

American eel were identified only within watercourses in the haul road PA, but absence of American eel within the mine footprint PA cannot be confirmed. Within the mine footprint, a single watercourse has been identified as providing habitat for American eel migration, juvenile rearing, and overwintering. Watercourse 5 is a direct tributary to the Killag River through Mud Lake and is present inside the mine footprint PA; however, direct impacts to this watercourse are not anticipated.

Expected and potential direct and indirect fish and fish habitat impacts to surface water features (wetlands and watercourses) in the immediate vicinity of the PA as a result of the Project construction and development within the mine footprint are described in Table 6.6-25, and Table 6.6-26 in Section 6.6.6. These direct and indirect effects of Project activities are expected to be similar in nature between priority fish species and all other fish species. Broader potential indirect impacts to down-gradient watershed water quality and quantity within the LAA are described in Section 6.3.6 and effects are evaluated within that section. Maintaining water quality and quantity downstream in the LAA is paramount for limiting broader fish and fish habitat impacts within each affected watershed associated with the Beaver Dam Mine, particularly those known to support priority fish species.

Development of the mine will cause direct impacts to fish and fish habitat mostly within the construction phase of the Project during clearing, grubbing, blasting, and development of the mine and its associated infrastructure. On-going impacts to fish and fish habitat are possible during operations of the mine from on-going dewatering efforts within the open pit and potential siltation and release of substances to receiving surface water systems adjacent to the mine infrastructure.

Construction of the haul road may cause impacts to fish and fish habitat mostly within the construction phase of the Project during clearing, grubbing, and construction of new road components where necessary. During construction, positive direct impacts to fish and fish habitat are also expected where current culverts that are hung or crushed can be either replaced or removed and fish passage and habitat re-established.

The Touquoy facility is currently under construction. There are no direct or indirect effects to priority fish or fish habitat anticipated to be caused by the processing of ore and the management of tailings from the Beaver Dam Mine Project. Effects to fish and fish habitat related to the Project are described in Section 6.6.

6.10.6.2 Priority Vascular Flora and Lichens

Development of the mine footprint and upgrading and construction of new sections of the haul road will result in direct impacts to vascular and non-vascular individuals and to flora communities at the full or partial forest stand level. The effects of the Project on flora encompass vascular and non-vascular priority flora species in aquatic, wetland, and upland habitats. As such, many of the effects described in Section 6.5 specific to wetland habitat and Section 6.7 (Habitat and Flora) will directly relate to effects on priority flora species. The majority of direct mortality to flora will occur during site preparation.

Within the mine footprint PA, three of the seven documented locations of frosted glass whiskers (*Sclerophora peronella)* are expected to be directly impacted, along with two of the three locations of Wiegand's Sedge (*Carex wiegandii)*, and the single location of lesser rattlesnake plantain (*Goodyera repens)* by construction of the Waste Rock Storage Area. Three of the twenty-six observed locations of blue felt lichen (*Degelia plumbea*) may be directly impacted by construction of a water diversion ditch (north of the open pit), the pit perimeter berm around the open pit, and the till stockpile. Impact to these individuals may be avoidable during the detailed design phase. The following species have been documented within close proximity to proposed infrastructure and may be indirectly impacted by development: frosted glass whiskers, *Sclerophora peronella* (4), blistered jellyskin lichen, *Leptogium corticola* (3), peppered moon lichen, *Sticta fuliginosa* (2), and Wiegands' sedge, *Carex wiegandii* (1).

Blue felt lichen, highbush blueberry, Appalachian polypody and southern twayblade are species of non-vascular and vascular flora which have been documented in the haul road PA. None of these individuals are found along the proposed alignment for the upgraded haul road or along the centerline of the section of new construction and an approximate 20 m buffer. While detailed design of the haul road layout is not yet complete, it is not anticipated that vascular or non-vascular flora priority species will be directly impacted by upgrading the existing road or by the construction of the new 4 km section of the haul road. As is possible, Atlantic Gold will work to avoid priority flora species during detailed Project design of the haul road upgrades. Within the mine footprint, micro-siting of infrastructure has been completed to avoid priority flora species wherever possible.

Indirect effects to habitat and flora described in Section 6.7 are relevant to priority flora species as well. Lichens are sensitive to changing environmental conditions, particularly air quality. As such, Project activities may indirectly affect priority lichen species which have been avoided, but exist in close proximity to Project infrastructure.

The Touquoy facility is currently under construction. There are no direct or indirect effects to vascular flora and lichen species of conservation interest anticipated to be caused by the processing of ore and the management of tailings from the Beaver Dam Mine Project. Effects to flora and habitat related to the Project are described in Section 6.7.

6.10.6.3 Priority Terrestrial Fauna

Terrestrial fauna priority SAR/SOCI observed during field surveys within the PA includes the mainland moose and the snapping Turtle. Each of these species has variable habitat preferences, depending on the time of year. Mainland moose are found in habitat mosaics of uneven age stands with abundant twigs and foliage for foraging. These uneven-aged mosaic forests that moose prefer can be formed from natural disturbance such as fire or wind throw, or anthropogenic disturbance such as timber harvesting. During the summer months, they are reliant upon aquatic systems (lakes, rivers, and wetlands) for submergent and emergent vegetation, and cover from thermal stress (NSDNR, 2007). Mainland moose are not particularly affected by habitat fragmentation based on habitat preference; however, increased access into a site (construction of new roads) may increase poaching levels. As such, low-level habitat fragmentation can indirectly affect mainland moose.

The snapping turtle can be found in a variety of freshwater ecosystems, such as slow-moving rivers, wetlands, lakes, streams, and ponds. Hibernation occurs in freshwater systems deep enough to prevent freezing through during the winter, with a mucky or muddy substrate. They are the most aquatic of freshwater turtles in Nova Scotia, but they do travel through upland habitat and use gravelly areas to nest. The preference for gravelly substrate during nesting is a threat to turtles, as gravid females are attracted to the gravelly shoulders of roads for nesting. The potential for direct mortality of reproductive females is highest where roads intersect or are adjacent to aquatic ecosystems. This risk is highest in June when females are nesting, particularly given the proposed increase in traffic along the haul road.

Development of the mine and associated upgrades to the haul road will cause direct impacts to habitat used by terrestrial fauna, including wetlands with suitable hibernacula for snapping turtles, and those with abundant submergent and emergent vegetation for mainland moose. Wetlands 8, 10, 11, 29, 59, 61, 66, 66, 68, 69, 159, 168, and 171 are identified as potentially providing hibernacula for snapping turtles where open water is present. The open water portions of Wetlands 8, 10, 11, 29, and 61 within the mine footprint PA are not proposed for direct impact. Wetland 59 has been identified as potentially providing hibernacula habitat for snapping turtles. This anthropogenic wetland will be directly impacted by construction of the open pit. All other wetlands with potential to support snapping turtles within the haul road PA (w wetlands 66, 68, 69, 159, 168, and 171) will have minimal impact proposed, associated with upgrade or construction of the haul road. Either these wetlands will be avoided, or where interactions may occur with proposed alignment, impacts to snapping turtle habitat are expected to be minimal, with proper mitigation. Impacts to wetland habitats will occur mostly within the construction phase of the Project during clearing, grubbing, and development of the mine and its associated infrastructure, and upgrading of the haul road (widening). Habitat within the PA currently exhibits fragmented conditions based on historic mine operations and current and historic timber harvesting activity within and adjacent to the PA.

Sensory disturbance to terrestrial fauna would result from rock blasting (1-2 times per week during operation), clearing and grubbing, infrastructure construction during the construction phase and, overall increased traffic, blasting, mining activities and trucking during operations within the PA. This would likely result in localized wildlife avoidance of the PA, including moose and snapping turtle. Increased human activity could result in increased usage of the PA by opportunistic species such as coyotes, raccoons, skunks, or black bears. Overall, Project activities could cause a change in usage of the PA by wildlife, with some species tending to avoid the area, while others may be attracted to the increased activity.

How wildlife species such as mainland moose and snapping turtle are affected by habitat availability, use, or fragmentation is determined by species habitat requirements (e.g., thermal, cover, security) and rates of movement through various habitats (With & Crist, 1995). Fragmentation of a particular species' habitat implies a loss of habitat, reduced patch size, and/or increasing distance between patches. However, fragmentation may also suggest an increase of new habitat (Andren, 1994). Therefore, the effect of habitat fragmentation on a species (population) would be primarily through not only habitat loss, but also habitat changes. Habitat patches are parts of the landscape mosaic and the presence of a species in a patch may be a function not only of patch size and isolation, but also of the neighboring habitat. In landscapes with more than 30% of suitable habitat, fragmentation is primarily habitat loss (With & Crist, 1995). Habitat generalists may survive in very small patches because they can also use resources in the surroundings. Furthermore, the total species diversity across habitats in a given landscape may increase when new patches of habitat are created within the continuous habitat, since new species may be found in these new habitats, even if they are human-made (Andren, 1994).

Habitat selection by wildlife is primarily a response to security, thermal comfort, and forage needs. Wildlife must balance these conflicting requirements. Habitat selection is species-specific and choices will depend on physiological constraints and social needs of the species. Literature in conservation biology indicates that maintenance of movement corridors of suitable habitat between population centres is fundamental to wildlife health (Bentz, Saxena, & O'Leary, 1994).

Although security and thermal cover are important, habitat selection is strongly influenced by relative foraging opportunities (Renecker and Hudson 1999). Requirements for security vary seasonally and are greatest when animals feel threatened. Wildlife is vulnerable at parturition and when accompanied by neonates, a condition that is exacerbated when the mother is in poor condition. To off-set this disadvantage, wildlife select habitats consistent with their physical attributes and cryptic coloration. For example, white-tailed deer escape cover in forests (Renecker & Hudson, 1999).

Studies completed by Buckmaster et al. (1999) indicate that wildlife populations may be expected to disperse from the area during periods of construction. However, this displacement is generally of short temporal disturbance as most cases reveal that wildlife have returned rapidly after human activity has ceased (Shank, 1979).

Changes to ambient noise levels and the presence of periodic vibrations have the potential to adversely affect fauna and birds by influencing migration and behavioral patterns. Noise and vibration is provincially regulated via the Workplace Health and Safety Regulations and the Pit and Quarry Guidelines, which protects the health of site workers and the general public at PA boundaries, respectively. If blasting is required near fish-bearing watercourses or waterbodies, guidelines identified by Wright and Hopky (1998) will be adhered to. Mainland moose are not likely significantly affected by noise and vibration, due to their ability to easily travel to avoid this disturbance. Hibernating snapping turtles, on the other hand, are unable to easily escape sensory disturbance easily during hibernation. As such, practices should be implemented to reduce blasting near wetlands with suitable snapping turtle hibernacula during hibernation. Hibernation generally occurs from October through March, depending on seasonal temperatures (i.e., hibernation can start later in a warm fall and end sooner in an early spring, and vice versa).

Direct mortality of priority fauna species could result from Project activities, particularly due to the increase in traffic during construction and operation of the facility. Increased traffic poses a risk to wildlife such as the mainland moose and snapping turtle along the entire length of the haul road between the Beaver Dam mine and the Touquoy processing facility. Indirect mortality to these species could also occur from exposure to contaminants or spills from unplanned incidents.

The Touquoy facility is currently under construction. There are no direct or indirect effects to priority fauna species anticipated to be caused by the processing of ore and the management of tailings from the Beaver Dam Mine Project. Effects to terrestrial fauna species related to the Project are described in Section 6.8.

6.10.6.4 Priority Birds

The assessment of potential adverse interactions and effects of the Project on this VC takes into account the potential for the Project to result in changes to:

- Permanent and temporary habitat alteration and fragmentation
- Disturbance and/or displacement

- Potential for direct and indirect mortality to individuals
- Attraction and disorientation resulting from night-lighting

With appropriate mitigation and monitoring, no direct mortality of priority bird species is anticipated, with the exception of the low potential for a bird strike with a haul truck. Avian usage of the PA during construction and operation of the Beaver Dam Mine will largely be driven by changes to habitat, resulting in localized avoidance of the PA by some species. Some priority species may avoid the PA in favor of undisturbed habitat in the surrounding landscape. Other priority species are anticipated to be attracted to the mine infrastructure and newly created habitat. The common nighthawk, for instance, is a crepuscular insectivore which nests on exposed gravel and disturbed areas. Lighting of buildings at dawn and dusk can create a foraging opportunity where insects are attracted to the lights. Barn swallows commonly nest in the eaves of built structures and bank swallows can nest in vertical slopes in sandy or silty soil, even in areas with high activity levels. These species of swallows have similar feeding habits as the common nighthawk. As such, Project activities may increase habitat suitability for both these species. If mitigated properly, the direct impact to these species is anticipated to be low.

The Touquoy facility is currently under construction. There are no direct or indirect effects to priority avifauna species anticipated to be caused by the processing of ore and the management of tailings from the Beaver Dam Mine Project. Effects to avifauna species related to the Project are described in Section 6.9.

6.10.7 Mitigation and Monitoring

The potential effects related to species and that are associated with the different phases of the Beaver Dam Mine Project are outlined in Tables 6.6-24, 6.7-7, 6.8-6, and 6.9-10, for each taxonomic group of species. Specific mitigation and monitoring measures related to priority species are outlined in the following sections.

6.10.7.1 Priority Fish Species

Standard mitigation and monitoring for fish and fish habitat is expected to appropriately mitigate effects on priority fish species. Watercourse alteration permitting will also be required, at which time detailed fish habitat quantification and potential effects on priority fish species will be addressed. The following mitigation efforts are considered in addition to those general fish and fish habitat mitigation measures outlined in Table 6.6-28 in Section 6.6.7.

- Baseline water quality and quantity in the Killag River has been collected as part of the EIS process and is described in Section 6.3. A monitoring program will be developed to measure post construction water quality and quantity in the Killag River, where the potential effect of the Project on surface water and priority fish species is the highest.
- Atlantic Gold has initiated contact with organizations with an interest in the local area with regards to fish habitat improvements, water quality, and overall watercourse health, including the Nova Scotia Salmon Association. Atlantic Gold will continue to work with these organizations to form partnerships so that data collected by any party can be used by others. Monitoring will also likely occur at the baseline sampling location on the West River Sheet Harbour and additional locations as directed by regulators;

- Site specific terms and conditions for alteration of watercourses which support priority fish species will be communicated to all site personnel and strictly adhered to; fish rescue will be completed within mine footprint PA prior to commencement of mine development;
- All culverts to be installed will be done in accordance with the NSE Watercourse Standard (2015) or as updated at time of construction to ensure fish passage through new culverts, and improving access by upgrading or removing improperly installed culverts, where possible; and,
- The location of all watercourses known to support priority species will be communicated to site personnel along with recommended mitigation measures.

6.10.7.2 Priority Vascular Flora and Lichens

No vascular flora SAR has been observed within the PA. Five priority species of vascular flora were identified across the PA both within the mine footprint and within the haul road PA. Three SAR lichens and 3 SOCI lichens were identified within the PA. Standard mitigation measures outlined previously in Sections 6.5 and 6.7 will provide appropriate guidance and in addition:

- Avoid SOCI wherever possible, particularly during micro-siting and detailed engineering of the haul road upgrades and new construction. Clearly identifying locations of SOCI where they will be avoided, and instruct personnel of their whereabouts;
- A map of all priority vascular and non-vascular flora will be provided to site personnel during site orientation, and the locations of all priority flora species that will be avoided during Project construction will be clearly flagged in the field;
- Atlantic Gold will transplant priority species, where deemed reasonable and appropriate in consultation with regulators, that are located within the direct footprint of the mine infrastructure or haul road to nearby areas where suitable habitat is present. Where avoidance or transplanting is not possible, the Project Team will collect vascular flora SOCI form areas proposed for direct impact for herbarium records or for preservation of seeds in a seed bank through Acadia University;
- Wherever avoidance of priority lichen species is not possible, the Project Team will consult with a lichen specialist to determine the likelihood of successful transplantation of SAR lichens to adjacent areas with suitable habitat. Where avoidance and transplantation is not possible, the Project Team will collect specimens for submission to Frances Anderson or equivalent contact at time of construction (Lichen Specialist, Research Associate, and Nova Scotia Museum); and,
- Lichens are particularly sensitive to changing environmental conditions, particularly air quality. AG will consult with a lichen specialist to develop a lichen monitoring program for those lichen SAR identified outside of, but in close proximity to, the Project Area to determine extent of indirect effects on those species.

6.10.7.3 Priority Terrestrial Fauna Species

- Standard mitigation for terrestrial fauna applies to SAR and SOCI;
- A Moose Management and Monitoring Program should be implemented during pre-construction, through operation of the Project. The Moose Monitoring plan should include

activities such as repeated winter track surveys and pellet group inventories, and collaboration with the Mi'kmaq of Nova Scotia to study Mainland Moose in a broader context;

- Wildlife observation reporting to appropriate site personnel during construction, operation and decommissioning of Project;
- Impacts to Snapping Turtles will be reduced by implementing a 30m buffer on aquatic habitat deemed suitable for Snapping Turtles, wherever possible;
- Where avoidance of potential turtle hibernation habitat is not possible, construction in these habitats should be limited to the growing season when hibernating turtles are not likely to be impacted (October through April);
- Culverts will be installed in wetlands and watercourses under provincial permits as required. Culverts can encourage reptiles and amphibians to cross through those, rather than crossing roads, particularly if approach to the road prevents access. This can be especially important for turtles during nesting season (June) when they are more attracted to gravelly roadsides;
- Wetland and watercourse alterations will be completed under approval from NSE, with associated mitigation, monitoring and compensation measures employed;
- Implement signage on the haul road during operations adjacent to major stream crossings or waterbodies, preferably signage that is installed only seasonally during turtles' active period as drivers are more likely to pay attention to new signs when they are erected prior to nesting season, for example, than if signs remain all year; and,
- Increase dust suppression on roads to improve visibility during nesting season and hatchling emergence.

6.10.7.4 Priority Birds

The potential effects related to migratory birds and the different phases of the Beaver Dam Mine Project are outlined in Table 6.9-10. Most direct and indirect impacts on birds, including SAR, are accounted for in general mitigation/monitoring for all birds, since many have legislated protection under the Migratory Birds Convention Act (primarily through avoiding clearing/grubbing during nesting season if possible, and conducting detailed pre-construction nest searches if clearing or grubbing must occur during nesting season). These pre-construction nest searches are particularly important in wetlands which provide suitable breeding habitat for the Olive-sided Flycatcher, Canada Warbler and Rusty Blackbird.

In order to verify the accuracy of the environmental assessment and the effectiveness of mitigation measures, a follow-up program is recommended. It is recommended that monitoring be conducted from the start of construction till the end of the decommissioning phase.

- Verify the effectiveness of mitigation measures related to light for a minimum of two years and, based on advice from appropriate jurisdictions, implement adaptive measures, if appropriate;
- Monitor known nests around stockpiles and exposed areas from a distance with a spotting scope or binoculars to verify the effectiveness of the buffer until the nests are inactive;

- Conduct routine inspections of the open pit to remove any trapped or injured wildlife;
- Notify Environment and Climate Change Canada within 24 hours in the event of the mortality or injury of ten or more migratory birds in a single event or in the event of the mortality or injury of a bird species at risk;
- Communicate regulations related to nesting birds to all site personnel, particularly focused on those priority bird species which may be attracted to Project activities. If nesting behavior of any bird is observed, site personnel are to report this activity to Atlantic Gold personnel as defined in the EPP so appropriate mitigation measures can be implemented as necessary; and,
- Clearing and construction can increase habitat quality for Common Nighthawk (CONI), increasing potential interactions with this species. To limit attraction of CONI to the Project Area, the Project Team should limit the amount of exposed soil during nesting season, favoring to cover or revegetate soil wherever possible.

6.10.8 Residual Effects and Significance

Based on avoidance, mitigation and monitoring proposed for all priority species listed above, the following residual effects are anticipated.

6.10.8.1 Priority Fish Species

Table 6.10-14 Residual Environmental Effects for Fish and Fish Habitat

Project Activities and Components	Mitigation and Compensation Measures	Nature of Effect	Significance Criteria for Residual Environmental Effects						Residual Effect	Significance
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social		
Clearing and grubbing (reduced infiltration, introduction of invasives)	Sediment and erosion control, reclamation during decommissioning and best management practices. (See mitigation: Table 6.6-28)	A	L	PA	LT	R	R	LD	Habitat Loss	Not Significant
Heavy machinery operation (impacts to water quality from dust, sediments, accidents and contamination)	Sediment and erosion control, spill preparedness and best management practices (See mitigation: Table 6.6-28)	A	M	PA	ST	R	R	LD	Disturbance	Not Significant
Direct fish habitat alteration (infilling, draining, flooding, altering wetland function, altering groundwater recharge capacity)	Engage wetland and watercourse permitting processes Wetland and surface water monitoring See mitigation: Table 6.6-28	A	M	PA	P	O	IR	LD	Habitat Loss	Not Significant
In-direct fish habitat alteration (water quality, hydrological imbalance, sedimentation)	Wetland and surface water monitoring See mitigation: Table 6.6-28	A	L	PA	M	S	R	LD	Disturbance	Not Significant
Widening and new haul road construction (hydrological changes, wetland and wc alteration and vegetation removal)	Engage wetland and watercourse permitting process Wetland and surface water monitoring See mitigation: Table 6.6-28	A	L	PA	P	O	IR	LD	Habitat Loss	Not Significant
Blasting (once per week) and drilling of in-situ rock	Pre-blasting plan and evaluation of potential to indirectly impact wetland habitat.	A	L	PA	ST	R	R	LD	Disturbance	Not Significant
Legend (refer to Table 5.10-1 for definitions)										

6.10.8.2 Priority Vascular Flora and Lichens

Table 6.10-15 Residual Environmental Effects for Habitat and Flora

Project - VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
Clearing and grubbing	Reclamation of mine footprint PA at end of Project.	A	H	PA	LT	O	R	MD	Habitat Loss	Not Significant
Heavy machinery operation	Monitor dust conditions on roads in periods with low rain. Practice spill preparedness.	A	L	PA	MT	R	R	LD	Disturbance	Not Significant
Vehicle activity for transportation of personnel and operating supplies	Monitor dust conditions on roads in periods with low rain. Practice spill preparedness.	A	L	PA	MT	R	R	LD	Disturbance	Not Significant
Widening of existing road and construction of new haul road	Maintain limits of work as per detailed design.	A	H	PA	LT	O	R	MD	Habitat Loss Disturbance	Not Significant
Haul truck activity	Monitor dust conditions on roads in periods with low rain. Practice spill preparedness.	A	L	PA	MT	R	R	LD	Disturbance	Not Significant
Vehicle activity from fleet of road trucks required to transport crushed ore	Monitor dust conditions on roads in periods with low rain. Practice spill preparedness.	A	L	PA	MT	R	R	MD	Disturbance	Not Significant
Legend (refer to Table 5.10-1 for definitions)										

Table 6.10-15 Residual Environmental Effects for Habitat and Flora

Project - VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		

Nature of Effect		**Geographic Extent**		**Frequency**		**Ecological and Social Context**	
A	Adverse	PA	Project Area	O	Once	LD	Low Disturbance
P	Positive	LAA	Local Assessment Area	S	Sporadic	MD	Moderate Disturbance
		RAA Area	Regional Assessment	R	Regular	HD	High Disturbance
Magnitude				C	Continuous		
N	Negligible	**Duration**		**Reversibility**			
L	Low	ST	Short-Term	R	Reversible		
M	Moderate	MT	Medium-Term	IR	Irreversible		
H	High	LT	Long-Term				
		P	Permanent				

6.10.8.3 Priority Terrestrial Fauna Species

Table 6.10-16 Residual Environmental Effects for Terrestrial Fauna

Project - VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context	Residual Effect	Significance of Residual Effect
Clearing and grubbing	Stockpile topsoil for remedial efforts upon mine completion	A	L	PA	MT	O	R	MD	Habitat Loss	Not Significant
Heavy machinery operation	Implement speed limits to reduce potential collisions with wild species	A	L	PA	MT	R	IR	LD	Disturbance , direct mortality	Not Significant
Vehicle activity for transportation of personnel and operating supplies	Implement speed limits to reduce potential collisions with wild species	A	L	PA	MT	R	R	LD	Disturbance, direct mortality	Not Significant
Construction and commissioning of support infrastructure	Install fences where practical to prevent wildlife access into areas with working equipment	A	L	PA	MT	O	R	LD	Disturbance	Not Significant
Widening of, and upgrades to existing haul road	Upgrade existing road where possible to limit the footprint of new construction	A	M	PA	LT	O	R	MD	Habitat Loss	Not Significant
Open pit lighting	Minimize lighting wherever possible	A	L	PA	MT	R	R	LD	None	Not Significant
Blasting (once per week) and drilling of in-situ rock	Follow guidelines for blasting outlined by the Pit and Quarry Guidelines	A	L	PA	MT	R	R	LD	Disturbance	Not Significant
Haul truck activity	Implement and enforce speed limit to reduce potential for collisions with wildlife	A	M	PA	MT	R	R	LD	Disturbance Direct Mortality	Not Significant

Table 6.10-16 Residual Environmental Effects for Terrestrial Fauna

Project - VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context	Residual Effect	Significance of Residual Effect
Primary crushing of ore	Install fencing, if practical, to prevent wildlife from entering crusher area	A	L	PA	MT	R	R	MD	Disturbance	Not Significant

Legend (refer to Table 5.10-1 for definitions)

Nature of Effect		Geographic Extent		Frequency		Ecological and Social Context	
A	Adverse	PA	Project Area	O	Once	LD	Low Disturbance
P	Positive	LAA	Local Assessment Area	S	Sporadic	MD	Moderate Disturbance
		RAA	Regional Assessment Area	R	Regular	HD	High Disturbance
Magnitude				C	Continuous		
N	Negligible						
L	Low	**Duration**		**Reversibility**			
M	Moderate	ST	Short-Term	R	Reversible		
H	High	MT	Medium-Term	IR	Irreversible		
		LT	Long-Term				
		P	Permanent				

6.10.8.4 Priority Bird Species

Table 6.10-17 Residual Environmental Effects for Birds

Project - VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
Clearing and grubbing	Bird awareness and management	A	M	PA	MT	O	IR	HD	Habitat Loss	Not Significant
Heavy machinery operation	Best management practices	A	L	PA	MT	R	R	MD	Disturbance	Not Significant
Vehicle activity for transportation of personnel and operating supplies	Best management practices	A	L	PA	MT	R	R	MD	Disturbance	Not Significant
Construction and commissioning of support infrastructure	Bird awareness and management	A	M	PA	MT	O	R	MD	Habitat Loss	Not Significant
Widening of existing road and construction of new portion of haul road	Bird awareness and management	A	M	PA	ST	O	IR	MD	Habitat Loss	Not Significant
Open pit and other site lighting	Best management practices See mitigation	A	L	PA	MT	R	R	MD	Attraction and disorientation	Not Significant
Blasting and drilling of in-situ rock	Best management practices See mitigation	A	M	PA	ST	R	R	LD	Disturbance	Not Significant
Haul truck activity	Best management practices	A	M	PA	MT	R	R	MD	Disturbance/ Mortality	Not Significant
Primary crushing of ore	Best management practices	A	M	PA	MT	R	R	MD	Disturbance	Not Significant
<u>Legend (refer to Table 5.10-1 for definitions)</u>										

Table 6.10-17 Residual Environmental Effects for Birds

Project - VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		

Nature of Effect
A Adverse
P Positive

Magnitude
N Negligible
L Low
M Moderate
H High

Geographic Extent
PA Project Area
LAA Local Assessment Area
RAA Regional Assessment Area

Duration
ST Short-Term
MT Medium-Term
LT Long-Term
P Permanent

Frequency
O Once
S Sporadic
R Regular
C Continuous

Reversibility
R Reversible
IR Irreversible

Ecological and Social Context
LD Low Disturbance
MD Moderate Disturbance
HD High Disturbance

6.10.9 Proposed Compliance and Effects Monitoring Program

As the Project moves forward, monitoring programs will proceed to gather pre-construction SAR and SOCI baseline data. Monitoring programs will continue during Project phases as appropriate to verify baseline conditions and to determine the effects of the Project on priority species in the PA. Section 6.10.7 summarizes the mitigation and monitoring activities that will be completed related to priority species. The details of the monitoring programs will be determined in consultation with regulatory agencies and will be described in the application for an IA for the site operations following the EA process. High level detail is needed in this application and would be subject to review by NSE and other agencies. An EMS and EPP will be developed as part of the Project implementation that will confirm the responsibility and system of accountability for the compliance and effects monitoring program.

The proponent is committed to engaging in wetland compensation activities for the wetland loss associated with the Project as required by the provincial wetland alteration process. A Wetland Compensation Plan will be developed and submitted to NSE with the goal of providing a final plan, prior to receiving wetland alteration approval. The wetland and watercourse alterations will include associated mitigation, monitoring and compensation measures.

The objectives of the SAR and SOCI monitoring programs are to:

- Verify effects predicted in the EIS;
- Confirm the continuing effectiveness of mitigation measures;
- Identify the need for any new mitigation measures; and
- Confirm compliance with regulatory approvals and requirements.

SAR and SOCI monitoring programs will the standard monitoring programs proposed for fish, habitat and flora, terrestrial fauna, and birds. Additionally, monitoring programs will be implemented specifically for SAR and SOCI which will include the following, as well as additional monitoring as determined through discussions with regulatory agencies:

- Priority Fish Species:
    - A monitoring program will be developed to measure post construction water quality and quantity in the Killag River, where the potential effect of the Project on surface water and priority fish species is the highest.
    - Monitoring will also likely occur at the baseline sampling location on the West River Sheet Harbour;
- Priority Terrestrial Fauna Species:
    - A Moose Management and Monitoring Program should be implemented during pre-construction, through operation of the Project. The Moose Monitoring plan should include activities such as repeated winter track surveys and pellet group inventories, and collaborating with the Mi’kmaq of Nova Scotia to study Mainland Moose in a broader context

- Wildlife observation reporting to appropriate site personnel during construction, operation and decommissioning of Project;
- Priority Lichens and Vascular Plants:
  - Standard monitoring outlined in Section 6.7.7 is considered appropriate for priority species
- Priority Bird Species:
  - Most direct and indirect impacts on birds, including SAR, are accounted for in general mitigation/monitoring for all birds outlined in Section 6.9.7, since many have legislated protection under the Migratory Birds Convention Act

6.11 Indigenous Peoples

6.11.1 Rationale for Valued Component Selection

Effects of changes to the environment on Indigenous Peoples are pursuant to subparagraph 5(1)(c) of CEAA 2012. This includes:

- Health and socio-economic conditions;
- Physical and cultural heritage, including any structure, site or thing that is of historical, archaeological, paleontological or architectural significance; and
- Current use of lands and resources for traditional purposes.

Under Nova Scotia's Environmental Assessment Regulations, there is a requirement to identify concerns of Indigenous Peoples about potential adverse effects and clarify the steps taken or proposed to be taken by the proponent to address concerns.

Further, the Crown has a duty to consult with Indigenous Peoples which is achieved under the Made-in-Nova Scotia Process. As per the CEA Agency Guidelines, the EIS will identify potential adverse impacts of the Project on potential or established Aboriginal or treaty rights, title and related interests.

As per the Updated Guidelines for Federal Officials to Fulfill the Duty to Consult (Government of Canada, 2011) and the Proponents' Guide: Engagement with the Mi'kmaq of Nova Scotia (Province of Nova Scotia, 2012), the Crown may delegate aspects of consultation to proponents though the legal duty to consult remains with the Crown.

The information collected during the Mi'kmaq engagement by Atlantic Gold and EIS development is expected to be used by the federal and provincial governments in the decision-making process.

6.11.2 Baseline Program Methodology

Four main components were used to define the baseline information for Indigenous Peoples:

- Ongoing engagement of the Mi'kmaq of Nova Scotia;
- Compilation of publicly available data on Mi'kmaq groups in Nova Scotia;

- Completion of a Mi'kmaq Ecological Knowledge Study (MEKS); and
- Completion of archaeological screening and reconnaissance.

The ongoing engagement activities and issues raised during the engagement, as well as a baseline description of Mi'kmaq groups in Nova Scotia that could be potentially affected by the Project is described in Section 4 of this EIS. The archaeological screening is described in Section 6.12 of this EIS; however, findings relevant to the Mi'kmaq are noted in this section. Issues raised during the Mi'kmaq engagement activities were considered in the overall development of this EIS as is described in Section 6.11.4.

An MEKS was initially completed by Confederacy of Mainland Mi'kmaq (CMM) for the proposed mine at the Beaver Dam site in 2009 as retained by GHD Limited (formerly Conestoga-Rovers & Associates) on behalf of Acadian Mining Corporation. In 2015, CMM was retained on behalf of Atlantic Gold to update the MEKS. Due to the change in the haul route to include approximately 4 km of new construction, CMM was retained again in 2016 to finalize the MEKS to include the revised Project Area and any additional information.

The purpose of an MEKS is to support the integration of Mi'kmaq knowledge of use and occupation of Mi'kmaq into development decisions via the EA process. The MEKS includes:

- a study of historic and current Mi'kmaq land and resource use;
- an evaluation of the potential impacts of the Project on Mi'kmaq use and occupation and constitutionally based rights;
- an evaluation of the significance of the potential impacts of the Project on Mi'kmaq use and occupation; and
- Recommendations to proponents and regulators that may include recommendations for mitigation measures, further study, or consultation with Mi'kmaq.

The MEKS was completed in accordance with the Mi'kmaq Ecological Knowledge Study Protocol (Second Edition) developed by the Assembly of Nova Scotia Mi'kmaq Chiefs. CMM is on the list of organizations who conduct MEKS in Nova Scotia as published by KMKNO. The MEKS does not intend to replace formal consultation with the Crown nor is it intended to replace an archaeological screening. While the MEKS includes oral interviews with Mi'kmaq knowledge holders, the MEKS is not intended to replace the Proponent's engagement activities with the Mi'kmaq.

The MEKS baseline information includes both historic and current Mi'kmaq land and resource use. As defined in the MEKS, the study area for current use is Project Area with a 5km radius while the historic use also includes a broader context within Halifax County. The current Mi'kmaq land and resource use in the area of the mine site is shown on Figure 6.11-1, completed as part of the MEKS.

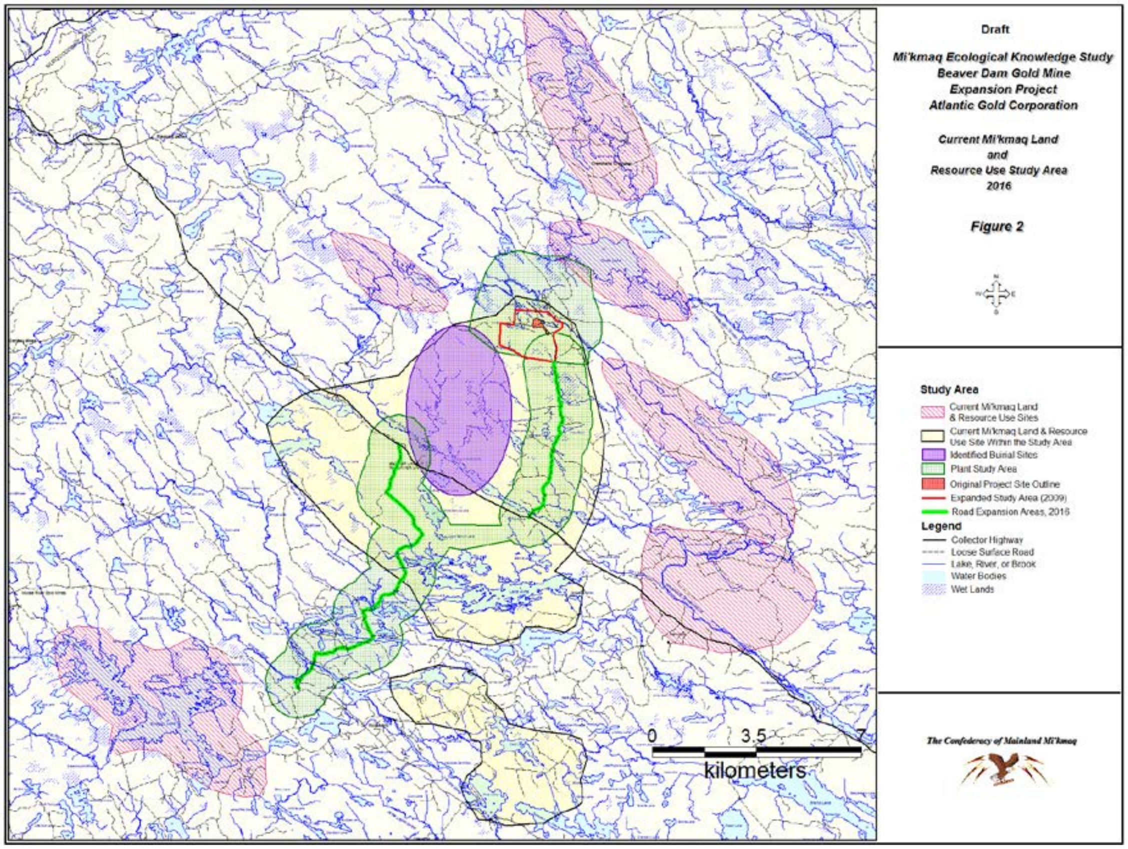


Figure 6.11-1 Current Mi'kmaq Land and Resource Use Study Area (MEKS, 2017)

A final draft was prepared in November 2016 with final edits completed in January 2017. The MEKS can be found in **Appendix N**. Upon offer of Atlantic Gold, the final MEKS was shared with staff of the two nearest Mi'kmaq communities.

It should be noted as well that an MEKS (pre-Mi'kmaq Ecological Knowledge Study Protocol) was completed for the Touquoy site. Mi'kmaq involvement and the results of the MEKS for Touquoy were documented in the EA for this project that can be found on the NSE Environmental Assessment website (http://novascotia.ca/nse/ea/MooseRiver.asp).

6.11.3 Baseline Conditions

There are 13 First Nations in Nova Scotia, the majority of which are Mi'kmaq. A summary of these First Nations is provided in Table 6.11-1 as described by Aboriginal Affairs and Northern Development Canada's First Nations Profiles (AANDC 2017). The locations of First Nations in Nova Scotia are also depicted below on Figure 6.11-2.

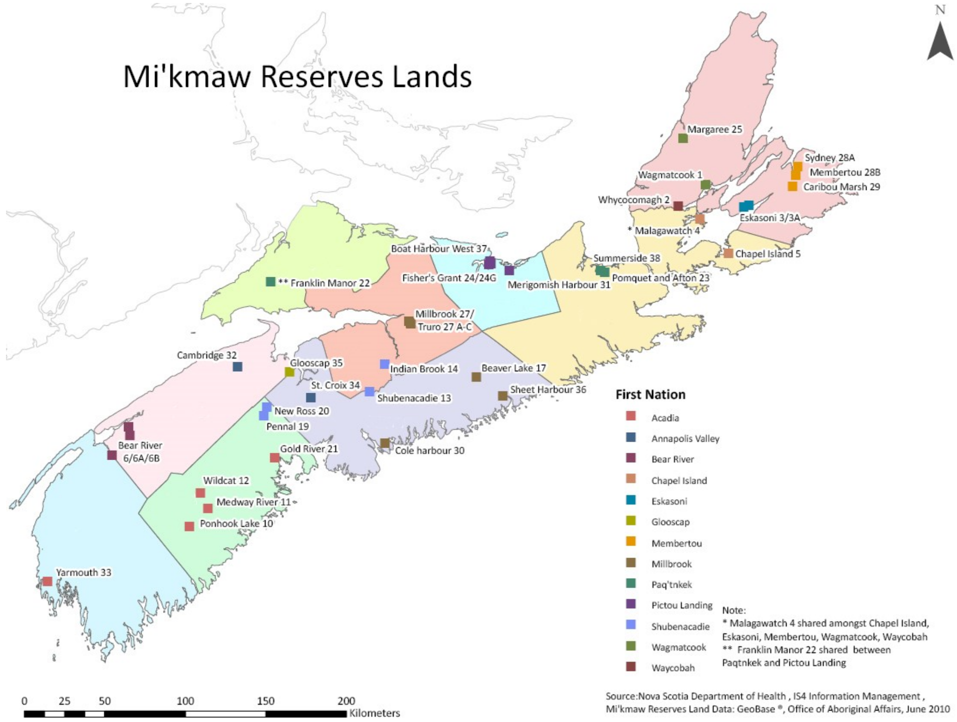


Figure 6.11-2 Summary of Mi’kmaw Reserve Lands in Nova Scotia

There are two First Nations (Mi’kmaq) reserves in the area of the Project. Beaver Lake IR 17 (49.4 ha) is located approximately 5.5 km from the mine site and 3 km from the proposed haul road. Sheet Harbour IR 36 (32.7 ha) is located 20 km south of the Project. Both of these reserves are administered by the Millbrook First Nation in Truro, Nova Scotia. The 2017 Census reports twenty-one (21) people are living at Beaver Lake and twenty-five (25) people are living at Sheet Harbour (Statistics Canada 2017, 2017a).

The Sipekne’katik First Nation, located in Indian Brook, Nova Scotia, is the next closest First Nations to the Project, located approximately 85 kilometres northwest of the Beaver Dam mine site. The 2016 Census reports that a total of 1,268 people are living on reserve at Indian Brook IR 14, New Ross IR 20, Pennal IR 19, Shubenacadie IR 13, and Wallace Hill IR 14A.

Table 6.11-1 First Nations in Nova Scotia

Band	Location	Chief	Reserves	Registered Population (2017)	On-Own-Reserve/Off-Reserve Population (2017)
Acadia	Yarmouth, Nova Scotia	Deborah Diane Robinson	Gold River IR 21; Medway River IR 11; Ponhook Lake IR 10; Wildcat IR 12; Yarmouth IR 33	1,524	230/1,289
Annapolis Valley	Cambridge, Nova Scotia	Gerald Bernard Toney	Annapolis Valley; St. Croix IR 34	290	117/173

Table 6.11-1 First Nations in Nova Scotia

Band	Location	Chief	Reserves	Registered Population (2017)	On-Own-Reserve/Off-Reserve Population (2017)
Bear River	Bear River, Nova Scotia	Carol Dee Potter	Bear River 6, 6A, and 6B	338	110/228
Glooscap	Hantsport, Nova Scotia	Sidney Carl Peters	Glooscap IR 35	375	94/280
Eskasoni	Eskasoni, Nova Scotia	Leroy Denny	Eskasoni IR 3 and 3A; Malagawatch IR 4	4,443	3,780/631
Membertou	Sydney, Nova Scotia	Terry Paul	Caribou Marsh IR 29; Malagawatch IR 4; Membertou IR 28B; Sydney IR 28A	1,500	904/552
Millbrook	Truro, Nova Scotia	Bob Gloade	Beaver Lake IR 17; Cole harbour IR 30; Millbrook IR 27; Sheet Harbour IR 36; Truro IRs 27A, 27B, 27C	1,831	872/916
Paqtnkek	Afton, Nova Scotia	Paul James Prosper	Franklin Manor IR 22 (Part); Paqtnkek-Niktuek IR 23; Welnek IR 38	573	404/141
Pictou landing	Trenton, Nova Scotia	Andrea Paul	Boat Harbour IR 37; Fisher's Grant IR 24 and 24G; Franklin Manor IR 22 (Part); Merigomish Harbour IR 31	663	483/157
Potlotek	Chapel Island, Nova Scotia	Wilbert Marshall	Chapel Island IR 5; Malagawatch IR 4	727	552/140
Sipekne'katik	Indian Brook, Nova Scotia	Michael Patrick Sack	Indian Brook IR 14; New Ross IR 20; Pennal IR 19; Shubenacadie IR 13; Wallace Hill IR 14A	2,645	1,268/1,298
Wagmatcook	Wagmatcook, Nova Scotia	Norman Francis Bernard	Malagawatch IR 4; Margaree IR 25; Wagmatcook IR 1	852	626/184

Table 6.11-1 First Nations in Nova Scotia

Band	Location	Chief	Reserves	Registered Population (2017)	On-Own-Reserve/Off-Reserve Population (2017)
Waycobah	Whycocomagh, Nova Scotia	Roderick Googoo	Malagawatch IR 4; Whycocomagh IR 2	999	883/81

6.11.3.1 Historic Mi'kmaq Land and Resource Use

Based on the proximity of the Project site to watercourses and fish habitat, it is likely that the Mi'kmaq settled in the MEKS study area. Traditional use of the land in Nova Scotia involved permanent and semi-permanent settlements. Semi-permanent settlements include summer villages which were often chosen near navigable watercourses and headwaters of rivers with spawning habitat potential, as well as smaller rivers flowing into a system of lakes. Settlements were also located near major waterways and harbours, providing accessibility to trade with the Europeans. The Mi'kmaq traveled inland through minor streams and rivers, either by canoe or on foot.

Beaver Dam lies within *Eskikewa'kik* or the "skin dressing territory" which spans from Halifax County to Guysborough County. While the MEKS notes that various authors and historians have differed in their description of this territory, all have agreed that Beaver Dam lies within this district. Seven main Mi'kmaq inhabitations are noted within *Eskikewa'kik*, including sites at Ship Harbour, Spry Bay Harbour and Liscomb Harbour near the MEKS study area.

The MEKS also notes that the site falls within the Meguma Terrane in the Atlantic Uplands of Nova Scotia; this geology has been used by the Mi'kmaq for grinding tools on other types of stone, bone, antlers and wood while hard stones, such as quartz, would have been used as hammers, choppers, knives and arrowheads.

In terms of hunting and gathering, the area contains a variety of spruce, fir, birch, ash, maple pine and shrubs inland, which would have been used in making baskets and building shelter. Fauna such as lynx, moose, beaver, deer, marten and hare were known to be drawn to the area; these animals were harvested for food by the Mi'kmaq.

While there is no pre-contact archaeological activity recorded within the MEKS study area, it is noted that due to harsh winters, strong winds, and erosion, there is little evidence remaining of early Mi'kmaq use and occupation.

The MEKS provides a description of Mi'kmaq use of land post-contact which is summarized as follows:

- In 1852, 100 acres at Beaver Dam was set aside on the Sheet Harbour Road at the head of Beaver Lake. Based on a survey in 1973 at Beaver Lake, it was found that the reserve contained 122 acres instead of the initial one hundred acres granted. The reserve was formally set-aside to Millbrook Band in 1960.

- In 1762, a proclamation was issued protecting the traditional hunting and fishing territories of Indigenous Peoples including a portion of Canso as far west as Musquodoboit. In 1783, a license of occupation was issued for 11,520 acres to protect fishing and hunting rights. Encroachment of European settlers occurred until the purchase of land to establish a formal reserve in 1915 at Sheet Harbour.
- In the first half of the 19th century, there is documentation of land laid out in the Ship Harbour area for Mi'kmaq individuals. As noted in the MEKS, the Mi'kmaq continued to use the area at Ship Harbour; however, the government wanted to centralize the Mi'kmaq on two main reserves at Shubenacadie and Indian Brook in 1919.

There are three specific land claims identified within the study area; however, the records of outstanding specific land claims are not currently fully researched as per CMM. It is understood that this is a joint claim with Millbrook and Sipekne'katik First Nations on unlawful surrender and illegal sale of three IRs in 1919: Sambro, Ingramport, and Ship Harbour. This process is ongoing and is not yet resolved with the Crown. Of these, only Ship Harbour is near the Project area, i.e., adjacent to the Beaver Lake IR 17 footprint as per the MEKS.

The Nova Scotia Museum records did not contain any archaeological sites within the MEKS study area. The adjoining areas have had some activity recorded in the Maritime Archaeological Resource Inventory. As per the MEKS, the information collected from that research has shown that Mi'kmaq presence occurred all around the MEKS study area.

6.11.3.2 Current Mi'kmaq Land and Resource Use

The MEKS includes a study of current Mi'kmaq land and resource use sites, species of significance to Mi'kmaq, and Mi'kmaw communities. The five categories that define current Mi'kmaq land and resource use utilized are:

- Kill/hunting: trout, eel, bear, rabbit, deer, porcupine, partridge, coyote, mink, muskrat, weasels, raccoon, fox, otter and beaver;
- Burial/birth: potential burial sites recorded within the MEKS study area on the western side of the Beaver Dam Mine Road but not within the Project area;
- Ceremonial: none identified
- Gathering: wild fruit, berries, water, food plant, specialty wood, logs, feathers, quills
- Habitation: anchored boat, travel route, overnight site

Species of significance to the Mi'kmaq are associated with three categories; these are listed below with the number of occurrences in the study area based on field work completed by CMM in summer 2016:

- Medicinal: 49 species present
- Food/beverage: 27 species present
- Craft/art: 11 species present

There are two IRs near the MEKS study area that were set aside under the *Indian Act* under the administration of Millbrook First Nation:

- Beaver Lake: established in 1867 and approximately 49.4 ha in size is situated along Hwy 224. The estimated population (Census 2016) on reserve is 21 with a total of five homes and four small cottages/camps.
- Sheet Harbour: set aside under Millbrook administration in 1960 and approximately 32.7ha along Hwy 7, the estimated population on reserve is 25 with a total of nine homes, two trailers, a community hall and a convenience/gas bar.

It should be noted that the Mi'kmaq of Nova Scotia regard information related to certain EIS Guideline items as their information. This includes frequency, duration or timing of traditional practices; access and travel routes for conducting traditional practices; areas of concentration of migratory animals, such as breeding, denning and/or wintering areas that are, have been or could be used by the Mi'kmaq. There is very little publically available information on these specific EIS Guideline items. Atlantic Gold has used information provided in the MEKS completed for the Beaver Dam Mine and haul road sites as well as the MEKS completed for the Touquoy Mine for the project design. Atlantic Gold respects the right of the Mi'kmaq of Nova Scotia's position on the ownership and use of the data and have therefore conducted a robust engagement program to gather information on the Project Area. This information has been incorporated into the final design of the mine site and the haul road which have been put forward in this EIS, without specifically documenting this information in this EIS or the Project Description document. It should be noted that in addition to the review of current Mi'kmaq Land and Resource Use, discussions with the Mi'kmaq led to changes in the design in order to mitigate potential effects. For example, the haul road was altered in order to mitigate the pathway of effects to the Mi'kmaq community from a safety, noise, air, and light emissions perspective, as well as other potential effects related to health and changes to socio-economic conditions. Further detail is provided in subsequent sections.

6.11.4 Consideration of Consultation and Engagement Results

Key issues raised during public consultation and Mi'kmaq engagement relating Indigenous Peoples include potential habitat loss and effects on individual flora and fauna used in traditional hunting, fishing and trapping activities and medicinal food and plants. Concerns related to pathways of impact from Project activities during construction and operation.

Specific questions were noted on potential effects of accidents and malfunctions on current use of traditional lands and associated contingency planning for an unplanned release. Concern included potential impacts to drinking water at the Mi'kmaq community of Beaver Lake and impacts to natural watercourses and receiving environs which may affect hunting, fishing and trapping activities.

Related to Mi'kmaq communities, many concerns were expressed in terms of the originally proposed haul route as it was planned to pass Beaver Lake IR 17 along Hwy 227. These concerns were primarily related to health (including noise, air quality and safety, etc.). Given the Proponent's decision to construct 4 km of new haul road to avoid travel along Hwy 224, concerns related to hauling near the Mi'kmaq community were addressed by the change to the Project. This change from the Project Description (October 2015) is documented in Section 2.3.5.

From a socio-economic perspective, interest has been expressed by the Mi'kmaq of Nova Scotia to work toward benefit agreement(s) with the Assembly of Nova Scotia Mi'kmaq Chiefs, as well as the two nearest Mi'kmaq communities of Millbrook and Sipekne'katik which are not currently part of the Assembly. These discussions and negotiations are ongoing and are direct between the Proponent and the Mi'kmaq of Nova Scotia. While not required by the Crown, they are considered best practice. Atlantic Gold sees maximizing benefits to the Mi'kmaq of Nova Scotia as an integral part of its corporate social responsibility program.

The results of Mi'kmaq engagement have been considered in the environmental effects assessment, including the Proponent's commitments on mitigation and monitoring measures and proposed compliance and effects monitoring programs. Section 4 provides additional information on Mi'kmaq engagement, including issued raised during Mi'kmaq engagement and Proponent responses. Ongoing engagement with the Mi'kmaq of Nova Scotia has been requested as part of Atlantic Gold's development in the Province.

6.11.5 Effects Assessment Methodology

6.11.5.1 Boundaries

Spatial Boundaries

Considerations of the assessment include effects on the environment that affects Indigenous Peoples' health and socio-economic conditions, physical and cultural heritage, including any structure, site or thing that is historical, archaeological, paleontological or architectural significance and current use of lands and resources for traditional purposes. The spatial boundary used for the assessment of effects to Indigenous People is the RAA. The Project has the potential to cause direct and indirect effects to health and socio-economic conditions, physical and cultural heritage, and current use of lands and resources for traditional purposes. The assessment of these aspects includes a 5 km radius from the Project Area in terms of physical effect directly on Indigenous Peoples. In a broader socio-economic sense and in terms of potential or established Aboriginal or treaty rights, title and related interests, the Province of Nova Scotia forms the spatial boundary.

Temporal Boundaries

The Project has three distinct phases - Construction (I year), Operation (3-4 years) and Reclamation (2-3 years) - that define the temporal boundary for assessment of impacts on the Mi'kmaq of Nova Scotia. The maximum Project life is 8 years.

Technical Boundaries

No technical boundaries were identified for the effects assessment of Indigenous Peoples.

Administrative Boundaries

Provincially, the Nova Scotia *Environmental Assessment Regulations* include a requirement to identify concerns of Indigenous People about potential adverse effects and steps taken or proposed to be taken by the proponent to address concerns, as well as the steps taken to identify these concerns.

Federally, subparagraph 5(1)(c) of *CEAA 2012* requires the assessment of effects of changes to the environment on Aboriginal peoples, including: health and socio-economic conditions; physical and cultural heritage, including any structure, site or thing that is of historical, archaeological, paleontological or architectural significance; and current use of lands and resources for traditional purposes.

The governments of Nova Scotia and Canada, and the Mi'kmaq follow a Terms of Reference consultation that lays out a process for Crown consultation with the Mi'kmaq. Procedural aspects of the Crown's duty to consult can be delegated to the Proponent.

6.11.5.2 Thresholds for Determination of Significance

A significant adverse effect is defined as a disturbance to or destruction of land and resources utilized by Indigenous Peoples, including potable water, surface water, fish, plants, and animals in the area of the mine site due to construction, operations, or accidents and malfunctions. A significant adverse effect is also defined as a negative effect to health or socio-economic conditions for Indigenous Peoples.

6.11.6 Project Activities and Indigenous Peoples Interactions and Effects

As per subparagraph 5(1)(c) of CEAA 2012, effects of changes to the environment on Indigenous Peoples include: health and socio-economic conditions; physical and cultural heritage, including any structure, site or thing that is historical, archaeological, paleontological or architectural significance; and current use of lands and resources for traditional purposes.

Potential interactions between Project activities and the Mi'kmaq of Nova Scotia are outlined in Tables 6.11-2 to 6.11-4 below.

Table 6.11-2 Potential Interactions with Project Activities and the Mi'kmaq of Nova Scotia at Beaver Dam Mine Site

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Clearing, grubbing, and grading in preparation of construction • Drilling and rock blasting in preparation of construction • Topsoil, till and waste rock transport and storage from site preparation • Existing settling pond dewatering in preparation of construction • Watercourse and wetland alteration • Mine site road construction, infrastructure installation, and collection and settling pond construction • Environmental monitoring of surface water discharges and adjacent wetlands • Accidents and malfunctions to include fuel and other spills, forest fires, settling pond overflow, an unplanned explosive event, and mobile equipment accidents
Operation and Maintenance	3-4 years	• Rock blasting to access and extract ore • Surface mine dewatering to facilitate access to and extraction of ore

Project Phase	Duration	Relevant Project Activity
		• Management of ore at the mine site • Management of waste rock produced from crushing and preparing ore for transport • Treatment of site surface water runoff and surface mine pumped water • Petroleum products management • Environmental monitoring • Accidents and malfunctions to include fuel and other spills, forest fires, settling pond overflow, an unplanned explosive event, and mobile equipment accidents
Decommissioning and Reclamation	1-2 years	• Site reclamation activities and infrastructure demolition • Environmental monitoring of adjacent wetlands • Accidents and malfunctions to include fuel and other spills, forest fires, and mobile equipment accidents

Table 6.11-3 Potential Interactions with Project Activities and the Mi'kmaq of Nova Scotia along Haul Road

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Clearing, grubbing, and grading in preparation of construction • Rock blasting in preparation of construction • Till and waste rock from site preparation transport and storage • Watercourse and wetland alteration in preparation of construction • Haul road construction and upgrades • Environmental monitoring of adjacent wetlands • Accidents and malfunctions to include fuel and other spills, forest fires, and a haul truck accident
Operation and Maintenance	3-4 years	• Ore transport along haul road • Road lighting • Haul road maintenance and repairs • Environmental monitoring • Accidents and malfunctions to include fuel and other spills, forest fires, and a haul truck accident
Decommissioning and Reclamation		N/A[1]

[1] *Decommissioning and Reclamation of the Haul Road is not expected. The haul road will be returned to owner for forestry industry*

Table 6.11-4 Potential Interactions with Project Activities and the Mi'kmaq of Nova Scotia at the Touquoy Processing and Tailings Management Facility

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Accidents and malfunctions to include fuel and other spills, forest fires, and mobile equipment accidents
Operation and Maintenance	3-4 years	• Environmental monitoring • Accidents and malfunctions to include fuel and other spills, forest fires, and mobile equipment accidents
Decommissioning and Reclamation	1-2 years	• Environmental monitoring • Accidents and malfunctions to include fuel and other spills, forest fires, and mobile equipment accidents

Many of the potential Project interactions listed above with the Mi'kmaq of Nova Scotia are via pathways of VCs that have been previously assessed as part of this EIS. This includes pathways for potential adverse effects to surface water, groundwater, wetlands, fish and fish habitat, habitat and flora, birds, fauna, SOCI/SAR, and human health; therefore, there are potential pathways to affect health and socio-economic considerations and current use of land and resources for traditional purposes.

Where the potential interaction relates to health and socio-economic considerations, given the proximity of the community of Beaver Lake which is part of Millbrook First Nation, located approximately 5 km south of the Beaver Dam mine site, this is noted in the sections below and summarized in Table 6.11-5.

Atmospheric

Based on the current Mi'kmaq land and resource use and the proposed project activities, the possible pathway to affect the Mi'kmaq of Nova Scotia from an Atmospheric perspective includes potential for direct effects to air quality, noise and light levels and the potential for direct contributions to climate change.

From an Air Quality perspective, dust emissions are the primary atmospheric issue for the Beaver Dam mine site. Sources of Project-related particulate matter on the mine site and haul road may include overburden removal, blasting, rock crushing, construction of haul road, etc. During operation, most of the dust will be generated at the mine site from crushing processes and trucking operations, and on the haul road from trucking operations.

With respect to potential effects of fugitive dust deposition on hunting/gathering (i.e. on aquatic and terrestrial species) as well as plant habitat (wild fruit, berries, food plant, etc), the MEKS was reviewed (as described in Section 6.11.3). Due to the proposed site operation and configuration, air emissions sources will be close to ground-level or below grade. Given the distance between Beaver Lake IR and the proposed project, coupled with the surrounding topography and surrounding forested areas, no interaction is expected to occur, nor will there be indirect significant effects on the Mi'kmaq of NS or on hunting/gathering. Further, mitigation measures such as dust suppression on site, and along the haul route, will reduce potential impacts on Beaver Lake IR as well as on site utilized for hunting/gathering. In addition, mitigation through design has occurred based on consultation with the Mi'kmaq of NS to move the haul route in order to eliminate trucks passing the Mi'kmaq community of Beaver Lake. Monitoring will be reported on an annual basis and mitigation measures will be modified accordingly

With respect to noise, sources of Project-related noise on the haul road may include heavy machinery and truck traffic during the construction and operational phases. Beaver Lake IR is located approximately 5km south of the project site and is separated by heavily forested lands and two topographic ridges. These ridges block direct views from the nearest sensitive receptors at Beaver Lake IR to all work areas. The nearest point of the haul road to the Beaver Lake IR is approximately 3 km. The haul road is currently in use for forestry activities and the activities on the haul road related to the Mine site will be similar in nature. A preliminary accoustical model did not identify any noise impacts directly to the Beaver Lake IR from the mine site or the haul road. The likelihood of the Beaver Lake IR being impacted by sound from the haul road is also very low.

There is also the potential for noise disturbance that may adversely impact local wildlife resources, including from a hunting perspective, which could affect the Mi'kmaq's hunting practices. The MEKS identified hunting of trout, eel, bear, rabbit, deer, porcupine, coyote, mink, muskrat, weasels, raccoon, fox, otter and beaver.

Project noise during the construction, operation, and decommissioning phases may affect the quality of fishing experience.

Further assessment of baseline monitoring before construction, during construction, and during mining operations will be conducted to ensure impacts are below the NSE guidelines and the Health Canada noise guidance which allows for an incremental increase in the percentage of highly annoyed population in the community to remain below 6.5% at sensitive receptors. Based on typical mining scenarios in rural regions of Nova Scotia, the predicted sound levels at the mine boundaries have the potential to exceed the noise goals during both daytime and evening operations. However, at 500 metres to 1 km from the mine the sound levels may be at or below the noise goals, with sound levels dropping towards the ambient levels with distance. Blasting events may provide a slight spike in the sound levels at distance for a brief period of time at the same time of day (daytime) once or twice a week. Because of the local nature of the noise impacts, their significance on local Mi'kmaq hunting activities is limited. Therefore, no interaction is expected to occur, nor will there be indirect significant effects from a noise perspective on the Mi'kmaq of NS. However, the proponent will work with the Mi'kmaq of NS to notify and or reduce noise on certain parts of the land/ during the project during key hunting seasons to ensure noise does not affect hunting activities.

In terms of effects from light, ambient night-time light levels on the mine site are not anticipated to affect the Beaver Lake IR community given the distance to the mine. The Beaver Lake IR is located approximately 5 km south of the mine site and is separated from the mine site by forest and two topographic ridges. These ridges block direct views from the nearest sensitive receptors at Beaver Lake IR to all work areas. The surface mine is located in a topographic depression and the crusher is in a more elevated position; however, distance to any sensitive receptors would mitigate any effects. The lighting effects would have a lower impact although it could be more widely experienced, especially if moisture or particulate matter are present in the atmosphere. The resulting halo of light above the mine might be seen from many locations. Although evident and given the rural setting of the site, it is not considered that it would cause any significant visual impact, due to a combination of large viewing distance and the screening effects of topography and vegetative cover.

Similar to noise, there is also the potential for light disturbance to adversely impact local wildlife resources, including from a hunting perspective, which could affect the Mi'kmaq's hunting practices. Light disturbance during the Construction, Operation, and Closure phases may affect the quality and ability of the Mi'kmaq to hunt for a specific species identified in the MEKS. Increased light may cause disturbance or displacement of species, while attracting other species, or general behavioral changes (DaSilva, Valcu and Kempenaers, 2015). For those species which may be attracted to lights, lights may increase potential for direct mortality of these species or may increase habitat suitability by supplementing their source of prey. Light can also alter habitat quality and sleep/wake cycles for terrestrial fauna within the immediate vicinity of the PA. This may decrease efficiency of nocturnal hunters. Some opportunistic wild species may be attracted to the site as a result of increased access and available food sources (natural prey or anthropogenic food sources). Installation of downward-facing lights on site infrastructure will assist in reducing potential effects from light disturbance and ensure that there are no effects on local Mi'kmaq hunting activities.

Geology, Soil & Sediment

Based on the current Mi'kmaq land and resource use and the proposed project activities, the possible pathway to affect the Mi'kmaq of Nova Scotia from a Geological perspective includes potential for direct adverse effects to soil and sediment and the potential for ARD from Halifax Formation bedrock. During the public consultation and Mi'kmaq engagement the key issued raised related to geology, soil and sediment were potential for ARD, suspended solids and leaching of metals from the rock at the Beaver Dam Mine site which may affect receiving water and its fish habitat, specifically Cameron Flowage, the closest watercourse to the Beaver Lake IR were raised as potential concerns.

Soil and sediment quality may facilitate exposure of birds, fauna, and fish that the Mi'kmaq of NS rely on as a food source, to contaminants through ingestion of soil. Creating a potential for change in the quality/health of hunted and fished species. As well as the potential for health impacts to the Mi'kmaq that consume the hunted and fished animals if there were to be a bioaccumulation of containments.

Potential ARD produced during exposure of Halifax Group or sulphide-bearing bedrock will increase the acidity of the surface water runoff and has the potential to create changes to fish habitat. These changes could lead to the potential for impacts to the abundance, health, distribution and behavior of the species fished by the Mi'kmaq.

The results of the public consultation and Mi'kmaq engagement have been considered in the environmental effects assessment, including the Proponent's commitments on mitigation and monitoring measures and proposed compliance and effects monitoring programs, as well as the Proponent's broader commitment to ongoing public consultation and Mi'kmaq engagement. Mitigation measures include sediment and erosion control measures through all phases of project. A monitoring program has been proposed that will conduct annual sampling at select baseline sediment locations (Sed. 1,2,3,6 and 7) for metals suite done for baseline and regular testing of rock for acid generating potential at a rate to be determined by NSE, anticipated to be no less than 1 sample per 100,000 tonnes of rock generated.

No residual effects for geology, soils and sediment are anticipated after implementation of mitigation and monitoring program, which have been designed to outline and avoid and monitor the potential long term residual impacts. Therefore no indirect significant effects are expected as a result the link between biophysical effects and effects to Aboriginal peoples.

Surface Water and Groundwater

Based on the current Mi'kmaq land and resource use and the proposed project activities, the possible pathway to affect the Mi'kmaq of Nova Scotia includes the potential for direct adverse effects to surface water and ground water quality and quantity.

General mining operations including the storage and handling of diesel, the use of ANFO for blasting, and the disturbance of soil and bedrock from site preparation, general construction, and operation of the surface mine has the potential to adversely affect surface water discharged from the Beaver Dam mine site. Disturbance of soil and bedrock through site preparation and construction, general maintenance including regrading and de-icing, and dust suspension from operation of the haul road also has the potential to adversely affect surface water quality in streams and rivers crossing the haul road through culverts and under bridges.

In a mine dewatering scenario, groundwater may experience draw down and therefore, the mine development could subsequently adversely affect surface water quantity in Cameron Flowage or adjacent wetlands. The storage of tailings in the mined out pit at Touquoy could affect surface water and groundwater quality

During the public consultation and Mi'kmaq engagement the key issues that were raised relating to surface water quality and quantity include potential effect from ARD, suspended solids and leached metals from the Beaver Dam Mine site activities. Potential effects on the quantity of surface water near the Beaver Dam pit were noted, specifically effects on water levels in Cameron Flowage. Concerns were identified related to effects on surface waters along the haul route, specifically during construction activities. At the Touquoy site, questions arose about potential effects on Moose River from placement of tailings in mined out pit. Potential effects on traditional uses of land and resources by the Mi'kmaq were noted, including importance of clean water to support the natural environment, including fish, flora, fauna and drinking water.

Key issues raised during public consultation and Mi'kmaq engagement relating to groundwater include potential effects on groundwater levels from mining the pit at Beaver Dam and groundwater quality associated with Project activities at the both the Beaver Dam Mine site and the Touquoy Gold Mine site. Concerns were specifically expressed by Millbrook First Nation regarding effects on groundwater quality and quantity in terms of potable water wells and the health of its residents in Beaver Lake.

Mi'kmaq's fishing opportunities and practices have the potential to be impacted through the change in the abundance and distribution of species fished and the change to fish health as a result of adverse water quality and quantity, and changes to water levels and flow.

There is also the potential for loss of drinking water sources around traditionally used trails, cabins and camps. As well there is the potential for health impacts to Mi'kmaq peoples through contamination of potable water wells. However, impacts to surface water and groundwater quality and quantity are not anticipated to affect Beaver Lake IR 17, which is a satellite community of the Millbrook First Nation given the distance from Project Area

The results of the public consultation and Mi'kmaq engagement have been considered in the environmental effects assessment, including the Proponent's commitments on mitigation and monitoring measures and proposed compliance and effects monitoring programs, as well as the Proponent's broader commitment to ongoing public consultation and Mi'kmaq engagement. Specific to evaluating the effect on surface water and groundwater quality and quantity, these are found within the following environmental effects assessment.

A number of mitigation measures will be applied to reduce the potential environmental impacts of the Project on surface water, listed in Section 6.3.7 and groundwater, listed Section 6.4.7. An annual review of the surface water, groundwater, and wetlands monitoring programs will be undertaken to determine potential interactions between these VCs. Revisions to the program will be completed as required.

Pollution prevention and mitigation measures and monitoring plan that will be employed at site the predicted residual environmental effects of Project development and production on groundwater are assessed to be adverse, but not significant. Therefore no indirect significant effects are expected to the Mi'kmaq's current use of the land and resources for traditional purposes.

The predicted residual environmental effects of Project development and production on groundwater are assessed to be adverse, but not significant. The overall residual effect of the Project on groundwater is assessed as not significant after mitigation measures have been implemented. Effects to groundwater supplies used for domestic purposes are not anticipated due to distance from site activities. The reclamation plan for the site includes a refilling of the pit to mimic the current conditions at the site so that post-mining conditions are not significantly different than baseline conditions.

Natural Environment

Based on the current Mi'kmaq land and resource use and the proposed project activities, the possible pathway to affect the Mi'kmaq of Nova Scotia from a Natural Environment perspective includes potential for direct loss and/or adverse effects to; wetlands, fish and fish habitat, terrestrial habitat, flora, birds, faun and SOCI/SAR.

Key issues raised during public consultation and Mi'kmaq engagement relating to the natural environment include;

- Direct impacts to wetlands during construction activities at the Beaver Dam mine site and during haul road construction, as well as potential indirect effects from Project activities.
- Overall potential effects on habitat loss from direct and indirect wetland impacts including potential effects to use by Mi'kmaq peoples for hunting, fishing, fowling trapping, and gathering.

- Adverse effects to fish and fish habitat from potential indirect effects from wetland alteration or changes to surface water and groundwater quality and quantity on fish and fish habitat
- Potential effect on biodiversity and permanent loss of habitat associated with footprint of the Beaver Dam Mine site and haul road.
- Potential effects on traditional uses of land and resources by the Mi'kmaq were noted, including medicinal food and plants.
- Potential for direct bird mortality associated with the hauling operation and indirect effects on other VCs, such as dust, noise and light, as well as potential effects on birds associated with permanent loss of habitat from construction of the Beaver Dam Mine and the haul road.
- Potential effects on fauna from permanent loss of habitat associated with the footprint of the Beaver Dam Mine site and haul road, as well as direct mortality associated with the hauling operation.
- Effects on traditional uses of land and resources by the Mi'kmaq were noted, including SAR/SOCI species of significance to the Mi'kmaq such as moose and American Eel.

Development of the mine and haul road will cause permanent loss of wildlife and plant resources within the immediate Project footprint and permanent alteration to a species' distribution or abundance, or alteration of critical habitat. The Project will have direct and indirect impacts to wetlands, fish and fish habitat, vascular and non-vascular individuals and to flora communities at the full or partial forest stand level, birds and terrestrial fauna. The assessment of potential effects of the project on the natural environment is discussed at length in Section 6.

The possible effects of the project on the biophysical components of the natural environment have the potential to effect the current use of the lands and resources by the Mi'kmaq for traditional purposes. These current uses include fishing, hunting and trapping, gathering, cultural practices.

There is a potential for change of fishing opportunities and practices due to potential:

- Change in access or ability to access or use land and resource areas,
- Perception of change in quality of the food and health of the environment for areas located near mines limiting fishing practices,
- Change in quality of the natural experience for Mi'kmaq harvesters and
- Effects to fish health, species abundance, distribution and diversity due to changes in water quality and ecosystem functions.

Hunting and trapping practices have the may be impacted through potential:

- Habitat loss
- Change in access or ability to access or use land and resource areas,
- Increased harvest pressure as an result of increased access to the area,

- Habitat alteration and displacement of wildlife due to sensory disturbance from noise from the mine's construction and operation and increased traffic and
- Change in quality of the natural experience for Mi'kmaq harvesters

Gathering opportunities and practices have the may be impacted through potential:

- Effects to culturally and economically important plants due to changes in ecosystem functions;
- Changes to quality of plant resources and abundance and associated habitat;
- Change in access or ability to access or use land and resource areas,
- Impact to human health to changes in country foods quality

In order to mitigate and reduce overall loss and function of the natural environment mitigation measures and monitoring plans have proposed. Also, the proponent is committed to engaging in wetland compensation activities for the wetland loss associated with the Project as required by the provincial wetland alteration process.

The predicted residual environmental effects of project development and production on the natural environment is assessed to be adverse, but not significant. There for no indirect significant effects are expected on Aboriginal peoples' current use of land and resources traditional purposes as a result of the link to biophysical effects.

Physical and Cultural Heritage

Based on the current Mi'kmaq land and resource use and the proposed project activities, the possible pathway to affect the Mi'kmaq of Nova Scotia from a Physical and Cultural Heritage perspective includes potential for direct adverse effects to Mi'kmaq archaeological sites. In addition, the MEKS noted that there are potential burial sites recorded within the MEKS study area on the western side of the Beaver Dam Mine Road but not within the Project area and no ceremonial areas/sites were identified.

There is low potential for the Project to interact with identified heritage resources that have been associated with historic mining at or near the Project site. The current plan is to avoid the areas identified above. If areas of known heritage resources are to be impacted, further work will be undertaken to document these resources. If heritage resources are identified during construction of the mine then all work will stop in the immediate vicinity until said resources can be further studied. The potential for heritage resources to be impacted exists primarily during the construction phase of the Project. While there has not been a confirmed Mi'kmaq archaeological significance of the Project site (based on the archaeological assessment undertaken for this undertaking), observations will be maintained during all construction activity and should evidence be uncovered all activity will cease in the area until Mi'kmaq archaeological experts have had an opportunity to examine the site and determine appropriate action.

Indirect significant effects on the Mi'kmaq of NS are not expected based on predicted residual effects.

Table 6.11-5 Pathway and Potential Effect of Valued Components with the Mi'kmaq of Nova Scotia

Valued Component	Health and socio-economic considerations	Physical and cultural heritage	Current use of lands and resources for traditional purposes	Possible pathway to affect the Mi'kmaq of Nova Scotia	Potential indirect effect based on effects assessment of other VCs
Atmospheric Environment	☑		☑	• Potential for direct effects to air quality, noise and light levels to affecting species harvested by the Mi'kmaq of NS • Potential for direct contributions to climate change which could alter the natural environment affecting the resources harvested by the Mi'kmaq of NS	• Indirect significant effects on the Mi'kmaq of NS are not expected based on predicted residual effects • No interaction in terms of noise, lighting, dust is expected given distance to Beaver Lake IR from Project Area
Geology, Soil, and Sediment	☑		☑	• Potential for direct adverse effects to soil and sediment affecting resources harvested by the Mi'kmaq of NS • Potential for ARD from Halifax Formation bedrock affecting surface water quality and in turn aquatic resources, including fish and fish habitat currently used by the by the Mi'kmaq of NS	• Indirect significant effects on the Mi'kmaq of NS are not expected based on predicted residual effects
Surface Water Quality and Quantity	☑		☑	• Potential for direct adverse effects to surface water quality and quantity impacted the aquatic ecosystem creating a potential pathway to alter the Mi'kmaq's current fishing practices	• Indirect significant effects on the Mi'kmaq of NS are not expected based on predicted residual effects

Table 6.11-5 Pathway and Potential Effect of Valued Components with the Mi'kmaq of Nova Scotia

Valued Component	Health and socio-economic considerations	Physical and cultural heritage	Current use of lands and resources for traditional purposes	Possible pathway to affect the Mi'kmaq of Nova Scotia	Potential indirect effect based on effects assessment of other VCs
Groundwater Quality and Quantity	☑		☑	• Potential for direct adverse effects to groundwater quality creating the possibility for unsafe drinking water	• Indirect significant effects on the Mi'kmaq of NS are not expected based on predicted residual effects • No interaction in terms of effect on potable water quality at Beaver Lake IR is expected given distance from Project Area
Wetlands			☑	• Potential for direct loss and/or adverse effects to wetlands impacting fish and fish habitat affecting current fishing practices	• Indirect significant effects on the Mi'kmaq of NS are not expected based on predicted residual effects
Fish and Fish Habitat			☑	• Potential for direct adverse effects to fish and fish habitat affecting current fishing practices	• Indirect significant effects on the Mi'kmaq of NS are not expected based on predicted residual effects
Habitat and Flora			☑	• Potential for direct loss of habitat affecting species distribution and abundance possibly affecting current Mi'kmaq hunting and trapping practices • Potential for direct adverse effects to flora affecting current gathering practices	• Indirect significant effects on the Mi'kmaq of NS are not expected based on predicted residual effects
Birds			☑	• Potential for direct adverse effects to birds affecting current fowling practices	• Indirect significant effects on the Mi'kmaq of NS are not expected based on predicted residual effects
Fauna			☑	• Potential for direct adverse effects to fauna	• Indirect significant effects on the Mi'kmaq of NS are not

Table 6.11-5 Pathway and Potential Effect of Valued Components with the Mi'kmaq of Nova Scotia

Valued Component	Health and socio-economic considerations	Physical and cultural heritage	Current use of lands and resources for traditional purposes	Possible pathway to affect the Mi'kmaq of Nova Scotia	Potential indirect effect based on effects assessment of other VCs
				affecting hunting and trapping practices	expected based on predicted residual effects
Species of Conservation Interest / Species At Risk			☑	• Potential for direct adverse effects to SOCI/SAR potentially affecting cultural and harvesting practices of the Mi'kmaq of NS	• Indirect significant effects on the Mi'kmaq of NS are not expected based on predicted residual effects
Physical and Cultural Heritage		☑		• Potential for direct effects to air quality, noise and light levels to affecting species harvested by the Mi'kmaq of NS • Potential for direct contributions to climate change which could alter the natural environment affecting the resources harvested by the Mi'kmaq of NS	• Indirect significant effects on the Mi'kmaq of NS are not expected based on predicted residual effects
Human Health and Socio-economic Considerations	☑			• Potential for direct adverse effects to soil and sediment affecting resources harvested by the Mi'kmaq of NS Potential for ARD from Halifax Formation bedrock affecting surface water quality and in turn aquatic resources, including fish and fish habitat currently used by the by the Mi'kmaq of NS	• Indirect significant adverse effects on the Mi'kmaq of NS are not expected based on predicted residual effects • No adverse interaction is expected on residents of Beaver Lake given distance from Project Area

While there are no expected indirect effects on the Mi'kmaq of Nova Scotia based on the effects assessment of the other VCs, this is based on the implementation of the mitigation and monitoring proposed for these other VCs as outlined in this EIS.

The MEKS evaluated three potential impacts and evaluated their significance. These are noted below in context of the effects assessment.

- While it is acknowledged that Mi'kmaq archaeological resources are extremely important to the Mi'kmaq as a method of determining use and occupation and as an enduring record of the Mi'kmaq First Nation and culture across the centuries, the potential Burial sites are not located within the proposed Project site and there is a low likelihood of pre-contact artifacts as per the archaeological study, therefore, direct effect of the Project is not expected to be significant as per the MEKS.
- While plant species of significance to Mi'kmaq were identified within the MEKS study area, these same species also exist within the surrounding area. While the destruction of some specimens is a Project effect, it does not pose a threat to Mi'kmaq use of the species; therefore, permanent loss of some specimens of plant species of significance to Mi'kmaq is not expected to be significant as per the MEKS.
- As hunting, gathering and trapping activities were identified in the MEKS study area and permanent loss of habitat is an impact of the Project, the MEKS evaluated the potential habitat loss located in and around the wetlands and lakes as potentially significant; however, given the relatively small footprint of this Project, existing disturbance in Project Area and proposed mitigation, monitoring, and follow up associated with other VCs, the direct effect on hunting, gathering and trapping activities if expected to be minimal. No effect is expected on the areas where the majority of hunting gathering and trapping activities occur, i.e., Tent Lake and Cope Pond, Rocky, Otter, Como, Grassy and Beaver Lakes, the Killag River, the West River, and the West River Sheet Harbour.

The Health Canada document "Useful Information for Environment Assessments" (HC 2015) was reviewed to determine the appropriate baseline information that should be included relevant to human health and First Nations. Table 6.11-6 presents the relevant information related to effects on human health of Indigenous Peoples based on the review of the Health Canada document. Based on the information below, there are no anticipated effects to human health related to Indigenous Peoples.

Table 6.11-6 Potential Effects on Human Health related to Indigenous Peoples

Elements to Consider	Anticipated Effect
Location of First Nations in relation to the Project	The nearest First Nation (Mi'kmaq) reserve is the Beaver Lake IR 17, located 5 km from the mine site and 3 km from the proposed haul road.
Size of the Population Potentially Affected	Twenty-one people are living at Beaver Lake.
Presence of Drinking Water Intakes	The nearest domestic well is 5.5 kilometres southwest from and up-gradient of the mine site, at a residence along Hwy 224.

Table 6.11-6 Potential Effects on Human Health related to Indigenous Peoples

Elements to Consider	Anticipated Effect
Recreational Use of Surface Water	The Project as planned does not restrict access to areas of documented use.
Country Food Harvesting	Based on the information compiled through the MEKS and findings during site visits, it is concluded that there is currently no direct Mi'kmaq use of the Project site for subsistence harvesting of food, medical plants or furbearing animals. It is known that areas to the west of the site have traditionally been used for these and ceremonial (burial) activities.
Location of Traditional Resource Use	

The Touquoy facility is currently under construction with full operation expected in Fall 2017. There are no effects to Indigenous Peoples anticipated to be caused by the processing of ore and the management of tailings from the Beaver Dam Mine Project with the exception of the continued potential for accidents and malfunctions and continued environmental monitoring. No increase in footprint is proposed beyond the approved construction now underway, and therefore no direct or indirect effects to Indigenous Peoples are expected through proposed Project operations. Consultation and engagement with Indigenous Peoples will continue throughout the life of the Touquoy facility.

6.11.7 Mitigation and Monitoring

Specific to the potential effects of the Project on the Mi'kmaq of Nova Scotia, and specifically the two closest communities of Millbrook First Nation and Sipekne'katik First Nation, the Proponent's mitigation and monitoring programs are primarily related to ongoing engagement and development of benefit agreement(s).

The mitigation measures and monitoring programs associated with other VCs are also key to avoid indirect effects on the Mi'kmaq of Nova Scotia. These are detailed elsewhere in this EIS and summarized in Sections 9 and 10.

It is understood that the consultation and negotiation will be completed by the Crown and the Mi'kmaq of Nova Scotia as part of the Made-in-Nova Scotia Process, including any rights-based issues negotiations and ongoing potential land claims.

The Project has been planned to minimize footprint disturbance and the proposed haul route has been changed to avoid passing the community of Beaver Lake. This greatly minimizes the residual effects on the Mi'kmaq of Nova Scotia, specifically Millbrook First Nation.

Table 6.11-7: Mitigation and Monitoring Program for Potential Effects on the Mi'kmaq of Nova Scotia

Project Activity	Mitigation Measures	Monitoring Program
Construction	In the event that Mi'kmaw archaeological deposits are encountered during construction or operation of the Project, all work should be halted and immediate contact should be made Laura Bennett, Special Places Coordinator, at the Nova Scotia Museum, the KMKNO and the Sipekne'katik and Millbrook Community	As part of the EMS and associated procedures under the EPP, the Proponent will ensure mitigation measures are undertaken to prevent irreversible damage to Mi'kmaq archaeological resources and burial site, including ensuring activities are within defined Project area
Ongoing	Engagement the Mi'kmaq of NS as per the engagement strategy, including specific participation in environmental monitoring and wetland compensation	Review of Mi'kmaq engagement strategy with the Mi'kmaq to be flexible as part of Project development
Ongoing	Continuation of the CLC which is made of up local community representatives including persons from the two nearest Mi'kmaq communities, Sipekne'katik and Millbrook First Nations	Review of Mi'kmaq input on specific actions and implementation where agreed with the Mi'kmaq CLC members
Ongoing	Implement specific engagement activities to address interest of the residents Beaver Lake, including information sharing, site tour, etc.	Complete and review approaches to specific engagement of nearby residents as mutually agreed with the Chief and Council and the staff of Millbrook First Nation
Ongoing	Share Project benefits with the Mi'kmaq of Nova Scotia via negotiated benefits agreement(s)	Monitoring of any future benefit agreement(s) as defined in the specific agreement, e.g., quarterly meetings of the implementation committee

6.11.8 Residual Effects and Significance

The predicted residual environmental effects of the Project on the Mi'kmaq of Nova Scotia are assessed to be adverse but not significant after mitigation measures have been implemented. The ongoing development of benefit agreement(s) with the Mi'kmaq is expected maximize positive effects associated with the Project. There are no significant adverse cumulative environmental effects anticipated on the Mi'kmaq of Nova Scotia.

Table 6.11-8: Residual Environmental Effects on the Mi'kmaq of Nova Scotia

Project - VC Interactions	Nature of Effect	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
Construction activities associated with mine site and haul road resulting in direct effect on archaeological resources and burial site	A	• Ensure no Project activities occur outside of Project Area • Education and procedures in place as part of EPP to halt work and notify the Mi'kmaq if archeological deposits encountered.	L	PA	ST	O	IR	LD	None	Not significant
Construction activities associated with mine site and haul road resulting in direct loss of plant specimens of significance to the Mi'kmaq	A	• Minimize footprint as per Project design. • Implementation of mitigation and monitoring of per other VCs to minimize indirect effects. • Engagement the Mi'kmaq in Project, including monitoring and compensation.	L	PA	ST	O	IR	LD	Loss of plant specimens	Not significant
Construction activities associated with mine site and haul road resulting in	A	• Minimize footprint as per Project design. • Implementation of mitigation and monitoring of per other	L	PA	ST	O	IR	LD	Habitat loss	Not significant

Table 6.11-8: Residual Environmental Effects on the Mi’kmaq of Nova Scotia

Project - VC Interactions	Nature of Effect	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
direct loss of habitat including wetlands		VCs to minimize indirect effects. • Complete wetland compensation as per NS policy. • Engagement the Mi’kmaq in Project, including monitoring and compensation.								
Operational activities restricting access during mine site operation and blasting	A	• Site restrictions will be within mine site PA and within flyrock management area during blasting activities only	L	PA	ST	S	R	LD	Restricted access to land and resources for traditional uses	Not significant
Employment and economic benefits	P	• Ongoing discussions to negotiate benefit agreement(s) with the Mi’kmaq of Nova Scotia.	L	LAA	MT	R	R	N/A	Benefits to the Mi’kmaq	Not significant
Legend (refer to Table 5.10-1 for definitions)										

Table 6.11-8: Residual Environmental Effects on the Mi'kmaq of Nova Scotia

Project - VC Interactions	Nature of Effect	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		

Nature of Effect A Adverse P Positive **Magnitude** N Negligible L Low M Moderate H High	**Geographic Extent** PA Project Area LAA Local Assessment Area RAA Regional Assessment Area **Duration** ST Short-Term MT Medium-Term LT Long-Term P Permanent	**Frequency** O Once S Sporadic R Regular C Continuous **Reversibility** R Reversible IR Irreversible	**Ecological and Social Context** LD Low Disturbance MD Moderate Disturbance HD High Disturbance

6.11.9 Proposed Compliance and Effects Monitoring Program

As the Project moves forward, benefit agreement(s) with the Mi'kmaq of Nova Scotia are expected to be developed for the MRC Project which includes the Beaver Dam Mine Project. The overall Mi'kmaq engagement strategy will continue to be implemented. Part of the draft benefit agreements being discussed and the Proponent's Mi'kmaq engagement strategy includes quarterly meetings with the Mi'kmaq of Nova Scotia, including Millbrook and Sipekne'katik First Nations, to review overall environmental compliance and effects monitoring programs.

While there are no specific compliance and effects monitoring programs proposed related to any direct effects on the Mi'kmaq of Nova Scotia, it is expected that the development of benefit agreement(s) and implementation of the overall Mi'kmaq engagement strategy will include regular review of compliance and effects monitoring programs associated with other VCs, as well as monitoring of Project benefits to the Mi'kmaq of Nova Scotia.

6.12 Physical and Cultural Heritage

6.12.1 Rationale for Valued Component Selection

Physical and cultural heritage are provincially regulated through the *Special Places Act*, which supports the preservation, regulation, and study of archaeological, historical, and paleontological sites and remains deemed to be important parts of Nova Scotia's natural or cultural heritage.

Given the proximity of the haul road and mine site to the Beaver Lake IR 17, the areas were identified as having high potential for pre-European contact natural and cultural resources. In addition, the Beaver Dam mine site area has been subject to extensive exploration and mining activity since gold was first discovered in 1868. These activities have left behind 20 AMO's and several other areas with high potential for post-European contact natural and cultural resources.

6.12.2 Baseline Program Methodology

In 2008, the archaeologist, Cultural Resource Management Group (CRM Group), undertook an archaeological screening and reconnaissance program at Beaver Dam Mine on behalf of Acadian Mining. At that time, an open-pit mine was proposed as well as associated mine features including a crusher, a settling pond, stock piles of overburden and product, and service roads.

In 2014, CRM Group was retained on behalf of Atlantic Gold to conduct archaeological screening and reconnaissance at the Beaver Dam mine site using the current site development plan. Building upon the research and reconnaissance undertaken on the property in 2008, CRM Group revisited several of the sites previously noted, as well as identified other features related to previous site activities (sawmill and possible cookhouse sites). The 2014 archaeological screening and reconnaissance consisted of a visual inspection of the ground surface and did not involve sub-surface testing. As part of the 2014 archaeological assessment, an archaeological screening was completed prior to Site reconnaissance. CRM Group reviewed documents available through the Nova Scotia Archives, the Department of Natural Resources and Crown Land Information Management Centre. The screening included a review of land grant records, legal survey, historical maps, local and regional histories, topographic maps, and aerial photos.

In 2015, CRM Group was retained on behalf of Atlantic Gold to conduct Additional Archaeological Reconnaissance. Changes to the layout of the proposed facility led to additional archaeological reconnaissance being undertaken in the summer of 2015. Previously investigated mine features, such as the WRSP and the crusher site had been reconfigured. Two till piles, two ore piles, two settling ponds, and the ROM/crusher/service pad site were added to the Project. The reconnaissance was focused within the pit, the WRSP, the till piles, the ore piles, the settling ponds, and the ROM/crusher/service pad site.

CRM Group was also retained in 2015 to complete archaeological reconnaissance of the proposed haul road where upgrades to the existing road will be conducted. The focus of the reconnaissance was on Beaver Dam Mines Road and Moose River Cross Road (so-called), which are portions of the proposed haul road that require upgrades to allow for truck travel. The water crossings exhibited the highest potential in the background research and were the focus of the reconnaissance. In 2016, CRM Group completed archaeological reconnaissance of a proposed 4.0 km new section of the haul road, located west of Hwy 224.

The 2015 and 2016 archaeological reconnaissance for the Beaver Dam mine site and the haul road consisted of a visual inspection of the ground surface and did not involve sub-surface testing.

The archeological reports are included in **Appendix O**.

The Touquoy site was previously subjected to archaeological reconnaissance in November 2006. No additional disturbances are anticipated at the Touquoy site as a result of the Beaver Dam Mine Project.

6.12.3 Baseline Conditions

Beaver Dam Mine Site

Site reconnaissance in 2008, completed as part of the archaeological assessment, noted 6 features, of which Sites 1 to 5 were within close proximity to Crusher Lake. Site 6 was located northwest of the lake. Two areas along the Cameron Flowage were identified as being high potential for pre-European contact resources. In addition to these features and high potential areas, numerous industrial features were identified along the northern shore of Crusher Lake. CRM Group recommended that the features and the high potential areas be subject to shovel testing and the industrial features subject to detailed documentation if any of them fell within areas of future development.

An archaeological screening was undertaken at the Beaver Dam mine site in 2014 that identified that the land within the study area was historically part of the greater Mi'kmaq territory known as *Eskikewa'kik,* meaning 'skin dressers territory'. The Maritime Archaeological Resource Inventory does not identify any registered archaeological sites within the study area. However, the lack of archaeological data may represent a lack of archaeological investigation and not an absence of archaeological sites. The Beaver Dam mine site property was historically developed for industrial use since the late-1800s. Aerial photographs from 1982 and 1992 indicate that the mine underwent a significant amount of development during this time period. This development likely destroyed any features that may have been present in the area.

Archaeological screening conducted in 2014 identified that, based on the environmental setting and Native land use, as well as the Property's long history of industrial use, the Beaver Dam mine site exhibits high potential for encountering Pre-contact and historic Native archaeological resources and high potential for encountering historic Euro-Canadian archaeological resources.

Based on the field reconnaissance completed as part of the 2014 archaeological assessment, historic features that had been identified in the Pit study area were determined to have been destroyed, likely by mining activities previously undertaken on the site during the 1980s. No archaeological features were identified within the WRSP study area. CRM Group recommended that any development around the features identified during the 2008 or 2014 reconnaissance would require shovel testing and intensified historical research. In addition, any development around Crusher Lake should be subjected to intensified reconnaissance. The pit and WRSP study areas, as they were oriented at the time of reconnaissance, were cleared of any requirement for further archaeological investigation.

The additional archaeological reconnaissance in 2015 determined that one historic feature (Feature 5) was identified within the Till Pile 2 study area. No archaeological features or areas of archaeological potential were identified within any of the other study areas, either during the background or field reconnaissance. It was recommended that either a program of shovel testing be conducted around the possible cookhouse (Feature 5) or a buffer of 20 metres be put in place around the feature to protect it from any mining activities. No further archaeological work is required for the rest of the till pile 2 study area. CRM Group recommended that any development around the features identified in 2008 and/or 2014 would require shovel testing and intensified historical research in advance of disturbance. The pit and WRSP, till Pile 1, the ore piles, the settling ponds, and the ROM/crusher/service pad study areas, as they were oriented at the time of reconnaissance, were cleared of any requirement for further archaeological investigation.

Haul Road

An archaeological assessment conducted for the haul road in 2015 identified that water crossings along the haul road, in particular the West River Sheet Harbour, would have been important transportation corridors for the Mi'kmaq and their ancestors prior to the arrival of European settlers. Faribault (1898) depicts several features in the vicinity of the haul road. This includes a camp within three kilometres of the alignment of the haul road and several dams located in the vicinity of Moose River Cross Road. Although no other features were depicted, dams would suggest further activity not noted on the Faribault map. Several houses and a First Nations reserve are located adjacent to what is now Hwy 224. The section of the haul road along Mooseland Road passes two camps, several structures noted as “Icelanders huts”, and a dam at the south end of Cope Lake. The review of Faribault indicates there is heavy activity in the area and that many of the modern road alignments follow closely to the historic alignments. The Maritime Archaeological Resource Inventory does not identify any registered archaeological sites within the study area. However, the lack of archaeological data may represent a lack of archaeological investigation and not an absence of archaeological sites.

During the 2015 and 2016 field reconnaissance, water crossings exhibited the highest potential in the background research and were the focus of the field investigations. The field reconnaissance did not identify any areas along the haul road that were ascribed high archaeological potential.

Based on the recommendations of the 2015 and 2016 archaeological reconnaissance, the alignment of the haul road, as specified at the time of 2015 site reconnaissance and including the proposed new section of road, was cleared of any requirement for further archaeological investigation.

Touquoy Processing and Tailings Management Facility

The entire Touquoy site was previously subjected to archaeological reconnaissance in November 2006. An archaeological screening was conducted by CRM Group to evaluate the archaeological potential within the proposed Touquoy development limits. The results of the study indicated that there is a low archaeological potential ascribed to the area. No additional disturbances are anticipated at the Touquoy site as a result of the Beaver Dam Mine Project.

6.12.4 Consideration of Consultation and Engagement Results

Issues raised during public consultation and Mi'kmaq engagement relating to physical and cultural heritage include potential disturbance of pre- and post-European contact archaeological resources.

The results of the public consultation and Mi'kmaq engagement have been considered in the environmental effects assessment, including the Proponent's commitments on mitigation and monitoring measures and proposed compliance and effects monitoring programs, as well as the Proponent's broader commitment to ongoing public consultation and Mi'kmaq engagement. Specific to evaluating the effect on physical and cultural heritage, these are found within the following environmental effects assessment.

6.12.5 Effects Assessment Methodology

6.12.5.1 Boundaries

Spatial Boundaries

The loss or destruction of heritage or archaeological resource material is a potential environmental effect of the Project. The spatial boundary used for the assessment of effects is the disturbed footprint of the project at the Mine site and along the haul road.

Temporal Boundaries

The temporal boundaries used for the assessment of effects to physical and cultural heritage are limited to the construction phase of the Project. Construction is estimated to take approximately one year.

Technical Boundaries

No technical boundaries were identified for the effects assessment of physical and cultural heritage.

Administrative Boundaries

Physical and cultural heritage are provincially regulated through the *Special Places Act*. In order to conduct any archaeological work, a Heritage Research Permit must be issued by the Minister of the Department of Communities, Culture, and Heritage.

6.12.5.2 Thresholds for Determination of Significance

A significant adverse effect is defined as a disturbance to or destruction of a cultural heritage resource where archaeological resources are identified.

6.12.6 Project Activities and Physical and Cultural Heritage Interactions and Effects

Potential interactions between Project activities and physical and cultural heritage resources are outlined in Tables 6.12-1 to 6.12-2 below.

Table 6.12-1 Potential Interactions with Project Activities and Physical and Cultural Heritage at Beaver Dam Mine Site

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Clearing, grubbing, and grading in preparation of construction • Drilling and rock blasting in preparation of construction • Topsoil, till and waste rock transport and storage from site preparation • Watercourse and wetland alteration • Mine site road construction and maintenance • Site infrastructure installation and construction • Settling pond construction • Accidents and malfunctions, including slope failure and mobile equipment accidents
Operation and Maintenance	3-4 years	N/A
Decommissioning and Reclamation	1-2 years	N/A

Table 6.12-2 Potential Interactions with Project Activities and Physical and Cultural Heritage along Haul Road

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Clearing, grubbing, and grading in preparation of construction • Rock blasting in preparation of construction • Till and waste rock from site preparation transport and storage • Watercourse and wetland alteration in preparation of construction • Haul road construction and upgrades • Accidents and malfunctions, including slope failure and mobile equipment accidents
Operation and Maintenance	3-4 years	N/A
Decommissioning and Reclamation		N/A[1]
1 Decommissioning and Reclamation of the Haul Road is not expected. The haul road will be returned to owner for forestry industry		

There is low potential for the Project to interact with identified heritage resources that have been associated with historic mining at or near the Project site. The current plan is to avoid the areas identified above. If areas of known heritage resources are to be impacted, further work will be undertaken to document these resources. If heritage resources are identified during construction of the mine then all work will stop in the immediate vicinity until said resources can be further studied. The potential for heritage resources to be impacted exists primarily during the construction phase of the Project.

There is no potential for the disturbance of cultural or physical heritage resources during the operational and reclamation phases of the Project.

There are no known federal decisions that could affect physical and cultural heritage in the PA, or that could affect structures, sites, or items of historical, archaeological, paleontological, or architectural significance of non-Aboriginal peoples.

The Touquoy facility is currently under construction. There are no effects to physical and cultural heritage anticipated to be caused by the processing of ore and the management of tailings from the Beaver Dam Mine Project. Effects to physical and cultural at the Touquoy facility are only anticipated to potentially occur during the initial construction phase for the Touquoy facility.

6.12.7 Mitigation and Monitoring

Mitigation and monitoring for the Beaver Dam mine site and the haul road are described below. Mitigation measures and monitoring programs at the Touquoy facility are anticipated to be completed during the construction and preparation of the Touquoy facility and will not be applicable for the Beaver Dam Mine Project.

The areas included in the 2014 and 2015 archaeological assessments were cleared of any requirement for further archaeological investigation. Based on the 2014 and 2015 archaeological assessments, the following mitigation activities were recommended by CRM Group and accepted by Nova Scotia Communities, Culture and Heritage:

- Either a program of shovel testing be conducted around the possible cookhouse (Feature 5) or a buffer of 20 metres be put in place around the feature to protect it from any mining activities.
- If any development is to occur within 100 metres of Crusher Lake, intensified reconnaissance should be conducted to identify any additional features.
- If any development is to occur specifically around the historic features identified during the 2008, 2014, and/or 2015 reconnaissance intensified historical research and archaeological shovel testing should be conducted in advance of disturbance.
- It is recommended that any further changes in the layout of the mine and associated facilities be evaluated as to potential impacts to archaeological resources.
- In the event that archaeological deposits or human remains are encountered during any ground disturbance associated with the Beaver Dam mine site or haul road, the Coordinator of Special Places, Nova Scotia Communities, Culture, & Heritage Department must be contacted.

Table 6.12-3 Mitigation and Monitoring Program for Physical and Cultural Heritage

Project Activity	Mitigation Measures	Monitoring Program
Construction	Either a program of shovel testing be conducted around the possible cookhouse (Feature 5) or a buffer of 20 metres should be put in place around the feature to protect it from any mining activities.	Ensure mitigation measures are undertaken to prevent damage to identified features.
	If any development is to occur within 100 metres of Crusher Lake, intensified reconnaissance should be conducted to identify any additional features.	
	If any development is to occur specifically around the historic features identified during the 2008, 2014, and/or 2015 reconnaissance intensified historical research and archaeological shovel testing should be conducted in advance of disturbance.	
	Any further changes in the layout of the mine and associated facilities be evaluated as to potential impacts to archaeological resources	
Operation	N/A	N/A
Decommissioning	N/A	N/A

6.12.8 Residual Effects and Significance

The predicted residual environmental effects of Project development and production on physical or cultural heritage resources are assessed to be adverse, but not significant. The overall residual effect of the Project on physical or cultural heritage resources is assessed as not significant after mitigation measures have been implemented.

Table 6.12-4: Residual Environmental Effects for Physical and Cultural Heritage

Project - VC Interactions	Nature of Effect	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
Construction – Damage to cultural/physical heritage resources	A	Shovel testing shall be conducted around the possible cookhouse (Feature 5) or a buffer of 20 metres be put in place around the feature to protect it from any mining activities.	L	PA	ST	O	IR	N/A	None	Not Significant
		Intensified reconnaissance if development will occur within 100 metres of Crusher Lake.								
		If any development is to occur specifically around the historic features identified during the 2008, 2014, and/or 2015 reconnaissance intensified historical research and archaeological shovel testing should be conducted in advance of disturbance.								
		It is recommended that any further changes in the layout of the mine and associated facilities be evaluated as to potential								

Table 6.12-4: Residual Environmental Effects for Physical and Cultural Heritage

Project - VC Interactions	Nature of Effect	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
		impacts to archaeological resources.								
		In the event that archaeological deposits or human remains are encountered during any ground disturbance associated with the Beaver Dam mine site or haul road, the Coordinator of Special Places, Nova Scotia Communities, Culture, & Heritage Department must be contacted								

Legend (refer to Table 5.10-1 for definitions)

Nature of Effect
A Adverse
P Positive

Magnitude
N Negligible
L Low
M Moderate
H High

Geographic Extent
PA Project Area
LAA Local Assessment Area
RAA Regional Assessment Area

Duration
ST Short-Term
MT Medium-Term
LT Long-Term
P Permanent

Frequency
O Once
S Sporadic
R Regular
C Continuous

Reversibility
R Reversible
IR Irreversible

Ecological and Social Context
LD Low Disturbance
MD Moderate Disturbance
HD High Disturbance

6.12.9 Proposed Compliance and Effects Monitoring Program

As noted above there is no determined need for compliance or effects monitoring programs related to physical and cultural heritage.

6.13 Human Health and Socio-economic Considerations

6.13.1 Rationale for Valued Component Selection

Human health from a site worker and general public perspective is provincially regulated via many legislative avenues within the *Occupational Health and Safety Act* and *Environment Act*. There may be potential for the Project to effect human health through indirect exposure to potential contamination via pathways such as the atmospheric environment, surface water quality and quantity, groundwater quality and quantity, and flora, fauna, fish, and bird consumption.

All phases of the Project will provide employment opportunities for local residents and Indigenous Peoples, as well as provide tax revenue for the municipal, provincial, and federal levels of government. It is anticipated that additional labour force will be required during construction and a smaller, but still significant, labour force will be required during operation - the operational labour force will come directly from the Touquoy Mine with additional trucking contractors required to haul ore between the sites. Indirect employment will be generated by the Project through the use of external contractors and suppliers. Tax revenue in the millions of dollars per year will be generated through corporate income taxes paid by Atlantic Gold, as well as its contractors and suppliers. Emphasis on the local economy may shift slightly from Middle Musquodoboit to Sheet Harbour depending on contract services for mine operation, however the overall regional economy will benefit equally from both sites operating simultaneously.

6.13.2 Baseline Conditions

6.13.2.1 Nova Scotia Economic Outlook

Economic growth in Nova Scotia has been the slowest of the Canadian provinces for more than 20 years. It is expected that Nova Scotia will see better economic growth over the near term, due in part to gains in export-oriented manufacturing and construction.

Real Gross Domestic Product (GDP) grew by 0.8% in 2015 and forecast to be 0.9% in 2016 and 0.8% in 2017. The nominal GDP growth in 2015 was 2.1% - limited by lower consumer prices; accelerated nominal GDP growth is expected in 2016 (2.5%) and 2017 (2.7%) spurred by several large projects including the shipbuilding program, the Maritime Link, Nova Centre, and offshore exploration. This growth is expected to slow beyond 2017 as some of these projects are concluded. Nova Scotia's GDP can be broken down as follows: production of goods (20%); private sector service (~50%); and, health, education and public administration (~30%). (NSFTB 2016)

Restricted labour force growth and a slowdown in potential output growth will be a result of the wave of retiring baby-boomers and a decrease in the province's population as immigration gains are offset by the aging population. This in turn will translate to financial challenges for government as the aging population limits the provincial revenue base. Inflationary pressures are expected to remain at bay over the long term, given the softer domestic demand. (Conference Board of Canada 2016)

Nova Scotia's unemployment rate is expected to edge slightly lower, due to a shrinking labour force brought about by a declining working age population. Despite negative employment growth in 2016, the unemployment rate has declined slightly (0.2%) since 2015. Net job creation is expected to resume in 2017; however with in-migration, unemployment rates will be modest. The aging of the Nova Scotia's population is increasingly taking a toll on the pool of available labour, although it is expect that his phenomenon will be partly offset by evolving interprovincial migration flows with Alberta (which has been a long-standing drain on the Nova Scotia population) (RBC 2016).

Local Economy

The Project area is located in the Halifax Regional Municipality (HRM) approximately 15 km north of Sheet Harbour on Hwy 224. The area economy is resource based with some services related to that industry stemming mainly from forestry, fishing and tourism with some mining/quarrying industries. The area has had previous benefit from mining at various locations within 50 km of the site. Sheet Harbour region has a population of about 5,000 people. The Village of Sheet Harbour is a commercial and services centre for the larger region with an accessible regional health care facility and shopping available.

This part of HRM and the adjoining County of Guysborough has the fourth largest proportion of outmigration patterns in Nova Scotia (ACOA 2009).

6.13.2.2 Socio-economic Conditions

Population and demographics

Industries – mainly in the resource sectors - have run through boom and bust cycles over the years. Each cycle attracts new or returning workers but also tends to push workers away when there is a downturn in the economy. There has, in this region, meant a decline in young families with school age children to support the school system and provide a trained worker base in the community. Youth are leaving the Eastern Shore to seek different experiences and more lucrative and/or longer term employment opportunities elsewhere.

Census Tract 2050154.00 (CT) includes Sheet Harbour and several surrounding communities including the Beaver Dam area, north and east to the Halifax County boundary. The total population base of this CT was 3,478 in the 2011 Census, a decline of 11.6 % from 2006. The population density is 2 people per square kilometer. In comparison the population of Nova Scotia increased by 0.9% and HRM by 4.7% (Statistics Canada 2011).

The age distribution in the Sheet Harbour CT indicates an older population with a median age of 51.4, (Nova Scotia - 43.7, HRM - 39.9). In 2011, 18.2% of the population were under the age of 20, and 24.5% of the population was 65 years or older. The male (49.4%) and female (50.6 %) population is nearly equal. The area is predominantly English (first language) speaking (98.3%) (SC 2011).

The cultural origins of the area are mainly Canadian/European; 8% identify as First Nations and about 1% is of Asian origin. The population identifies with a Christian religion (89%) with nearly

10% having no religious affiliation (SC 2011). The population of this CT remained fairly constant from the 2011 Census with 7% noting having moved within the previous year as compared to 18.6% having moved in the area 5 years previously (SC 2011).

Of the population between 25 and 64 years of age, at least 20% have attained a high school diploma and 53% have received a post-secondary education (apprenticeship or trade certificate - 34%, college diploma/university certificate – 50%, university degree (bachelor's or higher) – 15%) (SC 2011).

The average employment income in 2010 of people 15 years or older in full time employment is $44,742. The average family income is $61,971 (after tax average - $53,426). If you compare couple-only families with couple-with-children families the average family income is $57,911 and $81,041 respectively.

Unemployment rates in Eastern Nova Scotia in 2016 averaged 15.2 % (range 14.7-16.5%).

Health and Well-Being

The Project site from Beaver Dam to Moose River is covered by the Nova Scotia Health Authority that provides services through community based facilities located at Middle Musquodoboit (Musquodoboit Valley Memorial Hospital (MVMH)) and Sheet Harbour (Eastern Shore Memorial Hospital (ESMH)). Both facilities offer a community emergency department (MVMH 8 am – 8pm; ESMH 24 hour) and a variety of other inpatient and outpatient services.

Table 6.13-1: Hospitals offerings services to the PA

Hospital	Services	Beds
Musquodoboit Valley Memorial	Acute Home Nursing Care, Clinical nutrition, Diabetic Clinic and Meals-on-Wheels, Diagnostic services including laboratory, EKG and radiology, Emergency services, Family Practice, Mental Health, Occupational therapy, Outpatient services, Palliative services, Public health, Physiotherapy, Social work,	6
Eastern Shore Memorial	Palliative and Respite Care, Acute Care, Outpatient/Emergency, Ambulatory Care, Diagnostic Imaging, Laboratory Services, Physiotherapy, Occupational Therapy, Clinical Nutrition, Social Services, Adult Day Clinic, Diabetic Clinic, Meals-on-Wheels, Addiction Prevention and Treatment Services, Public Health Home Care Nova Scotia, Nova Scotia Hospital Outreach, IWK Health Centre - Metal Health and Family Services	Not specified

A new elder care facility, Harbourview Lodge Continuing Care Centre, is attached to ESMH. Braeside Nursing Home is located in Middle Musquodoboit. Social services are offered in both centres. Several denominations of churches are found between Sheet Harbour and Middle Musquodoboit.

Public Safety

This part of Halifax Regional Municipality is protected by the Royal Canadian Mounted Police (RCMP), based in Sheet Harbour, and is considered to have a very low crime rate (Greater Halifax Partnership). The crime rate, including violent crime, property crime and other crime (expressed per 10,000 people), in Halifax County (outside the urban core) is generally half of the corresponding urban Halifax crime rate. The five year average of total crime incidents is 485 /10,000 in the county. The provincial rate in 2015 was 1172 /10,000 (Stats Canada 2016). Violent crime has risen but total crime has decreased. There was a double homicide in Sheet Harbour in December 2012 that remains unsolved, and a suspicious death in August 2016.

The Halifax Regional Fire & Emergency Service has fire stations located at Sheet Harbour, Upper Musquodoboit and Middle Musquodoboit that are in close proximity to the Site. They also have several other stations on the Eastern Shore that can be called out depending on the complexity and severity of an incident.

Recreation and Tourism

The presence of unauthorized cabins and hunting blinds on private land is a good indicator that the area is used for hunting and fishing activity. The area is open to several seasons of hunting that include deer, bear, snowshoe hare, ruffed grouse and ring-necked pheasant to name a few. Recreational fishing occurs in areas near the Site.

The Snow Mobile Association of Nova Scotia trail system stretches 3,500 km connecting twenty local snowmobile clubs across Nova Scotia. Discussions are underway with local associations, including the Lake Charlotte ATV Association. The network of logging roads in this part of HRM could be used by local residents as trails to access recreational activities

The nearest recreational facility is in Sheet Harbour is the Seaside Fitness Centre, which offers trained staff to assist with fitness goals. The Musquodoboit Valley Bicentennial Theatre & Cultural Centre is a non-profit volunteer-operated organization located in Middle Musquodoboit that operates both as a community centre and as a fully-equipped 230 seat performing arts theatre. Taylor Head, located southwest of Sheet Harbour, is a natural environment, day-use, provincial park that offers 16 km of unspoiled Atlantic coastline.

First Nations Communities

There are two First Nations (Mi'kmaq) reserves in the area of the Project. Beaver Lake IR 17 and Sheet Harbour IR. These First Nations communities are discussed in more detail in Section 6.11.3.

6.13.2.3 Infrastructure

Housing

The total number of occupied dwellings in the Census Tract (2050154.00) in 2011 was 1,590. The majority (81%) of these are single detached homes that were owned by respondents (18 % were rented and < 1% Band housing) (SC 2011). The homes (81%) were occupied primary maintainers over the age of 45 and 79% of home owners or tenants spend less than 30% of their income on shelter related expenses (average $592 / month). The average value of dwellings in 2011 is $142,500.

Temporary Housing

There are several Bed & Breakfast (2), motels (3) and campgrounds (2) in the Sheet Harbour area that cater to both tourist and business traffic. Most are seasonal operations (May to October) but some offer service outside of the tourist season.

Water, Wastewater and Solid Waste Management

Water supply in the region is by drilled or dug well. Wastewater is managed through individual septic fields. Solid waste management is handled by the municipality in the form of weekly garbage and recyclable collection. Waste transfer stations are located at Middle Musquodoboit and Sheet Harbour and solid waste is disposed of at the Otter Lake Waste Processing and Disposal Facility.

A water supply survey was conducted in Sheet Harbour in 2006 to determine if there was a need or desire for a central water supply. Those locations on drilled wells had little to no bacteria but reported high mineral content, while those on dug wells had higher bacteria and few complaints of mineral content. While nearly 97% surveyed felt a central supply would benefit the community, only 85% said they would support it at minimal cost per household. No water supply has been built to date.

6.13.3 Land and Resource Use

6.13.3.1 Existing Land Use

The Project mine site is located in the Halifax Regional Municipality approximately 20 km northeast of Sheet Harbour and 7 km east of Highway 224 at Marinette. The surrounding area is undeveloped land that has had resource use (forestry, mining) for a century or more. The property is accessed by the Beaver Dam Mines Rd that is classed as a public right of way up to the mine site. Beyond that point roads are private resource roads developed by forestry companies to access the interior areas of the region. The network of roads is extensive and provides access to the public for recreational activity, namely for hunting, fishing and ATV use. There is no residential development at the mine site, the nearest being more than 5 km to the west.

The haul road labeled as the Moose River Cross Rd is located through an area of managed forest by several forest companies and is part of a warren of logging roads. This road connects Highway 224 and Mooseland Road. There are no residences along this road; however several seasonal properties are located in the vicinity of the road, near the western terminus with Mooseland Rd. This area also sees public use for access to hunting, fishing and ATV activity.

6.13.3.2 Land Ownership and Tenure

The mine site is located on land predominantly owned by Northern Timber Nova Scotia Limited (8 parcels) and the Province of Nova Scotia (one parcel). Northern Timber also owns lands adjacent to the Beaver Dam Mines Rd, a Crown-owned public right-of-way. One parcel of Crown land is adjacent to this road.

The haul road is a private logging road owned by the various land owners that include Northern Timber and the Province, and for the last 1.5 km owned by Musquodoboit Lumber Co. and Prest Bros. Ltd.

The Beaver Dam mine site and Touquoy processing and tailings management facility are located in the Musquodoboit Valley and Dutch Settlement Plan Area. The Land Use By-law and Municipal Planning Strategy for this area were last amended in October 2014. The area is zoned mixed use and extractive facilities, of which mining related infrastructure is one, are permitted within this zoning designation. The by-law for mixed use land use prescribes minimum separation distances from features such as lot lines, dwellings, watercourses, domestic wells, and residential zones. The physical activity of mining or extraction is not specified in the by-law as it is governed in the provincial and federal regulatory regime (pers. comm. L. Walsh 2016).

The majority of the haul road is located in the Eastern Shore (East) Plan Area, while a minor portion is located in the Musquodoboit Valley and Dutch Settlement Plan Area. The area is zoned mixed use under the Musquodoboit Valley and Dutch Settlement Land Use By-law, and rural resource under the Eastern Shore (East) Land Use By-law. Haul roads are not specified in either by-law as these are governed in the provincial regulatory regime (pers. comm. L. Walsh 2016).

6.13.3.3 First Nation Land and Resource Use

The Confederacy of Mainland Mi'kmaq completed a MEKS for the Project in 2015, which is provided in **Appendix N** and discussed in detail in Section 6.11. Based on the information compiled through the MEKS and findings during site visits, it is concluded that there is currently no direct Mi'kmaq use of the Project site for subsistence harvesting of food, medical plants or furbearing animals. It is known that areas to the west of the site have traditionally been used for these and ceremonial (burial) activities.

The Mi'kmaq community continues to harvest plant species throughout Nova Scotia and the area around the Project Mine site is no exception. Harvesting of trees and plants such as maple, ash, and birch for tools and crafts continue wherever these resources are known to occur. This is also true for blueberries, cranberries, strawberries and fox berries. The MEKS also noted that several species of medicinal plants continue to be collected in the region.

6.13.3.4 Protected Areas, Nature Reserves, and Parks

Several databases maintained by NSDNR and NSE, including the Restricted and Limited Land Use database and the more recent (December 2015) assignment of protected lands to Wilderness Areas, Provincial Parks and Nature Reserves indicated areas in proximity to the proposed Project:

- Tait Lake Nature Reserve (1.6 km north of mine);
- Twelve Mile Stream Wilderness Areas (4 parcels – closest is 5.2 km east of Mine site);
- Liscomb Game Sanctuary (no restrictions to mining – 7.3 km east of site);
- Tangier Grand Lake Wilderness Area (2.2 km south of intersection of Moos River Cross Road and Mooseland Road);

- Ship Harbour Long Lake Wilderness Area (west and adjacent to Mooseland Rd, south of Touquoy mine);
- Middle Musquodoboit Natural Water Supply Area (9 km north of Beaver Dam mine, 6.3 km north of Touquoy mine); and
- Significant Habitats are identified as:
  - Mainland Moose Concentration Area (entire Project Area);
  - Deer wintering Areas (9 km west of Beaver Dam mine);
  - Areas with Species of Concern (5.2 east of Beaver Dam mine; 3.2 km and 8.9 km northeast of Touquoy; south and adjacent to Touquoy;

These protected areas and areas of significant habitat features are shown on Figure 6.13-1.

6.13.3.5 Tourism and Recreation

Other than those areas and activities described above there are no designated Tourist or recreational areas within 20 km of the mine site.

Hunting and fishing are popular activities in rural Nova Scotia. Hunting includes large game such as white tail deer and bear. Smaller species may also be hunted and or trapped in the region – hare, fox, bobcat, beaver, etc. Moose hunting is prohibited on the mainland. The Nova Scotia Salmon Association (NSSA) monitors the Killag River where most of the salmon spawning occurs in the West River Sheet Harbour system. Other species that may be fished are species of trout (NSSA 2015). The exact area of monitoring is not indicated by NSSA.

The closest recreational facility is located in Sheet Harbour, which provides programs in sport/fitness, wellness and general interest. The Halifax County Exhibition is an annual event that occurs at Middle Musquodoboit.

6.13.3.6 Natural Resource Use

Natural resources include forestry, mining and water. As previously stated the region of the Project has had considerable activity related to forest harvesting activities and locally from mineral exploration and mining activities extending more than 100 years. There is no water use for any purpose currently. Historically, a flume was known to have been used from Crusher Lake to power mills for forest and mining activity.

6.13.4 Consideration of Consultation and Engagement Results

Issues raised during public consultation and Mi’kmaq engagement relating to human health and socio-economic considerations include potential adverse effects associated with potential effects to natural environments (e.g., surface water, groundwater, air emissions, etc.) during planned Project activities and unplanned accidents and malfunctions, such as traffic accidents. Questions on access to land and changes to land use were noted by members of the public and land owners, as well as the Mi’kmaq of Nova Scotia in terms of access to traditional land and resources. Maintenance of existing access for recreation, such as ATV, fishing, etc., was also identified as an issue. Volume of trucks on existing public roads was expressed as a key concern in terms of safety and road condition. Members of the public and Mi'kmaq community members expressed interest in employment and economic development opportunities associated with the Beaver Dam Mine Project.

The results of the public consultation and Mi'kmaq engagement have been considered in the environmental effects assessment, including the Proponent's commitments on mitigation and monitoring measures and proposed compliance and effects monitoring programs, as well as the Proponent's broader commitment to ongoing public consultation and Mi'kmaq engagement. Specific to evaluating the effect on human health and socio-economic considerations, these are found within the following environmental effects assessment.

6.13.5 Effects Assessment Methodology

6.13.5.1 Boundaries

Spatial Boundaries

Since the Project site is remote, the spatial boundary for assessment of potential impacts to the local economy extends beyond the footprint of the Project since there is no opportunity for the purchase or exchange of goods and services within that footprint. This spatial boundary, therefore, extends along Highway 224 to local centres Middle Musquodoboit and Sheet Harbour, and regionally to Halifax, Nova Scotia. The purchase of goods and services in the local affected area will be previously established with the development of the parent project at Touquoy, however, potential for additional services from the Sheet Harbour area may be apparent with the development of Beaver Dam. With respect to land and resource use, the spatial boundaries are considered to be the Project footprint, the affected area of the Project, and Halifax Regional Municipality (HRM). For tourism the spatial boundary is outside the affected area. The spatial boundary of assessment for hunting and fishing is within the Project footprint, the affected area, and regionally which would include HRM, Guysborough and Colchester.

Temporal Boundaries

The Project has three distinct phases - Construction (I year), Operation (3-4 years) and Reclamation (2-3 years) - that define the temporal boundary for assessment of impacts on the socio-economic components of the Project. The maximum Project life is 8 years.

Technical Boundaries

Economic effects potential is a qualitative assessment based on a comparison of the relative scale of predicted Project-related employment levels (person-hours; wages) with existing employment opportunities within the HRM, especially the area between Middle Musquodoboit and Sheet Harbour. Statistical data is used where available for these VCs.

Administrative Boundaries

The Nova Scotia *Municipal Government Act* (1998 c.18 s.1) empowers the Halifax Regional Municipality to enact and enforce a Municipal Planning Strategy (HRM MPS 2014) that describes Halifax's approach to planning within its jurisdiction. The MPS outlines criteria for Council and planning staff to consider when evaluating development proposals and issuing development permits. Together with the Land Use Bylaw and Subdivision Bylaw, the MPS controls future land use and development in the Municipality. Recreational activities, such as hunting and fishing are regulated by the Province of Nova Scotia under the *Wildlife Act* and for hunting migratory birds by federal authority under the *Migratory Birds Convention Act*, 1994 and *Migratory Birds Regulations*

6.13.5.2 Thresholds for Determination of Significance

A significant positive effect of the Project is a long term employment gain and/or sustained economic activity within the Study Area; whereas long term decreases in economic activity or employment opportunities within the Study Area could be a significant adverse Project effect on the Local Economy.

Enhanced cultural or economic value of land to the community that is consistent with the regulatory planning process is a positive effect of the Project .Within the Study Area, there is no pervasive change in land use patterns that would adversely affect a community's use of that land. Use of land that is inconsistent with a designated land use established through a municipal planning process is a significant adverse effect on Land and Resource Use.

6.13.6 Project Activities and Health and Socio-economic Conditions Interactions and Effects

Potential interactions between Project activities and Human Health and Socio-economics are outlined in Tables 6.13-2 to 6.13-4 below.

Table 6.13-2 Potential Interactions with Project Activities and Human Health and Socio-Economics at Beaver Dam Mine Site

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Clearing, grubbing, and grading in preparation of construction • Drilling and rock blasting in preparation of construction • Topsoil, till and waste rock transport and storage from site preparation • Wetland and watercourse alteration • Mine site road construction • Surface infrastructure installation and construction • Collection and settling pond construction • Accidents and malfunctions to include fuel and other spills, forest fires, slope failure, collection/settling pond failure, an unplanned explosive event, and mobile equipment accidents
Operation and Maintenance	3-4 years	• Rock blasting to access and extract ore • Surface water management • Petroleum products management • Site maintenance and repairs • Environmental monitoring

Table 6.13-2 Potential Interactions with Project Activities and Human Health and Socio-Economics at Beaver Dam Mine Site

Project Phase	Duration	Relevant Project Activity
		• Accidents and malfunctions to include fuel and other spills, forest fires, slope failure, collection/settling pond failure, an unplanned explosive event, and mobile equipment accidents
Decommissioning and Reclamation	1-2 years	• Infrastructure demolition • Site reclamation • Environmental monitoring • Accidents and malfunctions to include fuel and other spills, forest fires, and mobile equipment accidents

Table 6.13-3 Potential Interactions with Project Activities and Human Health and Socio-Economics along Haul Road

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Clearing, grubbing, and grading in preparation of construction • Rock blasting in preparation of construction • Till and waste rock from site preparation transport and storage • Watercourse and wetland alteration • Haul road construction and upgrades • Environmental monitoring • Accidents and malfunctions to include fuel and other spills, forest fires, and a haul truck accident
Operation and Maintenance	3-4 years	• Ore transport along haul road • Haul road maintenance and repairs • Environmental monitoring • Accidents and malfunctions to include fuel and other spills, forest fires, and a haul truck accident
Decommissioning and Reclamation		N/A[1]

[1] *Decommissioning and Reclamation of the Haul Road is not expected. The haul road will be returned to owner for forestry industry*

Table 6.13-4 Potential Interactions with Project Activities and Human Health and Socio-Economics at the Touquoy Processing and Tailings Management Facility

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction	1 year	• Accidents and malfunctions to include fuel and other spills, forest fires, and mobile equipment accidents
Operation and Maintenance	3-4 years	• Environmental monitoring • Accidents and malfunctions to include fuel and other spills or unplanned releases, forest fires, and mobile equipment accidents
Decommissioning and Reclamation	1-2 years	• Environmental monitoring • Accidents and malfunctions to include fuel and other spills or unplanned releases, forest fires, and mobile equipment accidents

The Health Canada document "Useful Information for Environment Assessments" (HC 2015) was reviewed to determine the appropriate baseline information that should be included relevant to human health. Table 6.13-5 presents the relevant information related to effects on human health of Indigenous Peoples based on the review of the Health Canada document. No potential contaminants of concern have been identified for the Project.

Table 6.13-5 Potential Effects on Human Health

Elements to Consider	Anticipated Effect
Air Quality	Dust from mining activities; greenhouse gas emissions from equipment, noise, and night-time light levels generated by the Project are anticipated to have little effect on human health (Section 6.1)
Country Foods	The mine site will not be accessible for food harvesting during the Project life. There are no contaminants of potential concern identified for the Project.
Drinking and Recreational Water Quality	The nearest domestic well is 5.5 kilometres southwest from and up-gradient of the mine site, at a residence along Hwy 224. Water sourced from wells will be treated as required for use at the wash house and for potable water supply. Recreational water quality may be impacted by sediment loading, as discussed in Section 6.3
Radiological Effects	There are no radiological sources from this Project.
Electric and Magnetic	There are no EMF sources from this Project.

Table 6.13-5 Potential Effects on Human Health

Elements to Consider	Anticipated Effect
Fields (EMF) Effects	
Noise Effects	The nearest noise receptor is 5.5 km southwest of the site. No noise impacts are anticipated as a result of the Project. (Section 6.1)
Human Health Risk	There are no contaminants of potential concern known to be associated with the Project; therefore there is no risk to human health identified. Any potential risk to human health will be mitigated by Occupational Health and Safety legislation and appropriate OHS corporate plans.

Positive socio-economic impacts are associated with the Project, including long term employment gain and/or sustained activity within the area. All phases of the Project will provide employment opportunities for local residents and Indigenous Peoples, as well as provide tax revenue for the municipal, provincial, and federal levels of government. It is anticipated that additional labour force will be required during construction and a smaller, but still significant, labour force will be required during operation.

Indirect employment will be generated by the Project through the use of external contractors and suppliers. Emphasis on the local economy may shift slightly from Middle Musquodoboit to Sheet Harbour depending on contract services for mine operation, however the overall regional economy will benefit equally from both sites operating simultaneously.

The construction of a new portion of road and upgrades to existing roads will provide local residents and recreational users improved access to the interior areas of the region.

There is low potential for the Project to cause adverse health and socio-economic conditions. The potential does exist for a mobile equipment accident along the haul road. Haul trucks will travel daily from the Beaver Dam mine site to the Touquoy processing and tailings management facility. The number of return truck trips per day will be an annual average of approximately 185 (370 one-way trips) for 12 or 16 hours per day, 350 days per year for the duration of the mine Project (3.3 years). During construction and pre-production (8 months), the number of trips will be less. The haul road will be dual lane and designed to facilitate the safe passage of two-way truck traffic at 70 km/h. Speed limit and right-of-way signage will be installed and all haul truck operators will receive operator training to minimize the risk of haul truck collisions. All intersections will be designed to NSTIR Standards. A haul truck accident may result in fuel and/or other spills, fires, and/or injury or death to site workers and the general public. Discussions with NSTIR will identify additional mitigation measures that may be required, in particular at the Hwy 224 crossing.

Atlantic Gold is not aware of any federal decision that could affect the health and socio-economic conditions of non-Aboriginal peoples.

6.13.6.1 Touquoy Processing and Tailings Management Facility

The Touquoy facility is currently under construction. There are no effects to human health and socio-economic conditions anticipated to be caused by the processing of ore and the management of tailings from the Beaver Dam Mine Project. The primary effect of the continued use of the Touquoy facility on human health and socio-economic conditions is the provision of employment for an additional four years in the processing facility, and the potential for accidents and malfunctions.

6.13.7 Mitigation and Monitoring

Recreational activities that currently occur within the spatial boundaries of the Project, such as hunting and fishing, will, for safety reasons, be restricted during construction and operation. Recreational users will be notified of restricted access by signage at the entrance to the mine site. Site restrictions will be within Project Area and within flyrock management area during blasting activities only. Liaison with local recreational groups, such as ATV associations, will be undertaken. Other recreational opportunities exist near the Project site, therefore, impacts caused by lack of use are considered to be an inconvenience but is not likely to be significant.

No monitoring, except restricting access for safety, will be undertaken after the start of construction. The local economy will not be monitored during the various phases of the Project.

A potential adverse effect on socio-economic conditions is related to a risk for mobile vehicle accidents along the haul road, in particular at the Hwy 224 crossing. Speed limit and right-of-way signage will be installed and all haul truck operators will receive operator training to minimize the risk of collisions. Intersection requirements and additional mitigation measures will be determined through discussions with NSTIR.

Table 6.13-6 Mitigation and Monitoring Program for Human Health and Socio-economic Considerations

Project Activity	Mitigation Measures	Monitoring Program
Site Preparation and Construction	• Restriction of recreational activities within the spatial boundaries of the Project. Notification will be provided by signage. • Liaison with any local recreation groups, such as ATV associations	N/A
	• Equipment maintenance • Reduction of mobile equipment accident risk through discussions with NSTIR, appropriate signage, and operator training	N/A
Operation	• Restriction of recreational activities within the spatial boundaries of the Project. Notification will be provided by signage. • Liaison with any local recreation groups, such as ATV associations	N/A
	• Equipment maintenance • Limiting haul truck operational hours to 12 to 16 hours per day	N/A

Project Activity	Mitigation Measures	Monitoring Program
	• Reduction of mobile equipment accident risk through discussions with NSTIR, appropriate signage, and operator training	
Decommissioning and Reclamation	N/A	N/A

6.13.8 Residual Effects and Significance

There are no significant adverse environmental effects anticipated on health and socio-economics, once mitigation measures are applied. Positive impacts are anticipated in the form of direct and indirect employment, and tax revenues for municipal, provincial, and federal governments. Additionally, improvements to local roads will be completed as part of the Project, which will provide improved access to the region's interior.

Table 6.13-7 Residual Environmental Effects for Human Health and Socio-Economic Considerations

Project - VC Interactions	Nature of Effect	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
Site Preparation and Construction (direct and indirect employment opportunities)	P	N/A	M	RAA	MT	R	R	MD	Creation of employment opportunities	Not Significant
Operation and Maintenance of Mine Site (direct and indirect employment opportunities)	P	N/A	M	RAA	MT	R	R	MD	Creation of employment opportunities	Not Significant
Site Preparation and Construction/Operation and Maintenance (Restriction of recreational activities within the PA during construction and operation of the mine site)	A	• Restriction of recreational activities within the spatial boundaries of the Project. Notification will be provided by signage; • Liaison with any local recreation groups, such as ATV associations	L	PA	MT	C	R	LD	Disturbance	Not Significant
Haul road construction, alteration, and maintenance (direct and indirect	P	N/A	M	RAA	MT	R	R	MD	Creation of employment opportunities	Not Significant

Table 6.13-7 Residual Environmental Effects for Human Health and Socio-Economic Considerations

Project - VC Interactions	Nature of Effect	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
employment opportunities; interior road network upgrades)										
Decommissioning and Reclamation (direct and indirect employment opportunities)	P	N/A	M	RAA	MT	R	R	MD	Creation of employment opportunities	Not Significant
Haul truck activity	A	Equipment maintenance, haul truck operation <24 hours per day	M	PA	MT	R	IR	MD	Disturbance	Not Significant
Mobile Equipment Accident	A	Reduce risks of an accident through operator training, proper signage at intersections and along the haul road, and discussions with NSTIR	M	PA	MT	R	IR	MD	Disturbance	Not Significant
Legend (refer to Table 5.10-1 for definitions)										

Table 6.13-7 Residual Environmental Effects for Human Health and Socio-Economic Considerations

Project - VC Interactions	Nature of Effect	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		

Nature of Effect		**Geographic Extent**		**Frequency**		**Ecological and Social Context**	
A	Adverse	PA	Project Area	O	Once	LD	Low Disturbance
P	Positive	LAA	Local Assessment Area	S	Sporadic	MD	Moderate Disturbance
		RAA Area	Regional Assessment	R	Regular	HD	High Disturbance
Magnitude				C	Continuous		
N	Negligible	**Duration**		**Reversibility**			
L	Low	ST	Short-Term	R	Reversible		
M	Moderate	MT	Medium-Term	IR	Irreversible		
H	High	LT	Long-Term				
		P	Permanent				

6.13.9 Proposed Compliance and Effects Monitoring Program

As noted above there is no determined need for compliance or effects monitoring programs related to health and socio-economic impacts. No follow-up monitoring will be undertaken respect to the effect of the Project on the local economy. Routine groundwater, surface water, and air monitoring will provide indicators of changes to the environment from the Project that may affect human health.

6.14 Assessment of Valued Components within Federal Jurisdiction

6.14.1 Environmental Effects within Federal Jurisdiction

This section summarizes those changes to the environment that may be caused by a Project on environmental components listed in paragraph 5(1)(a) of CEAA 2012. This includes fish and fish habitat as defined in the *Fisheries Act*, migratory birds as defined in the *Migratory Birds Convention Act, 1994,* and species designated by the *Species at Risk Act.* These VCs have been discussed in greater detail in the Sections above (in particular Sections 6.6, 6.9, and 6.10) and are summarized below. However, it is not anticipated that changes to the environment arising as a result of a federal decision will affect migratory birds or species at risk. It has been determined that fish and fish habitat as defined in the *Fisheries Act* is the only project component for which a federal authorisation/decision may be required. This is discussed in greater detail in the following sections.

Fish and Fish Habitat

Development of the mine will cause direct impacts to fish and fish habitat mostly within the construction phase of the Project during clearing, grubbing, blasting and development of the mine and open pit and its associated infrastructure. Continuing impacts to fish and fish habitat are possible during operations of the mine from on-going dewatering efforts within the open pit, and potential siltation and release of substances to downstream receiving surface water systems adjacent to the mine infrastructure.

Construction of the haul road may cause impacts to fish and fish habitat mostly within the construction phase of the Project during clearing, grubbing and construction of new road components and road widening where necessary. During construction, positive direct impacts to fish and fish habitat are also expected where current culverts that are hung or crushed can be either replaced or removed and fish passage and habitat re-established.

Further work to understand potential fish habitat and fish presence at specific alteration locations will be required to support surface water permitting (wetlands and watercourse alteration). Mitigation will be implemented to reduce the potential for direct fish mortality where fish were observed through fish rescue efforts prior to commencement of construction and completion of relevant construction activities within confirmed fish habitat within approved timing windows for construction (June 1 to Sept 30) to reduce potential for mortality of eggs and juvenile fish.

Maintaining water quality and quantity downstream in the PA and LAA is paramount for limiting broader fish and fish habitat impacts within each affected watershed associated with the Beaver Dam Mine haul road PA. However, indirect impacts to down-gradient watershed water quality and quantity within the PA and LAA that may affect fish and fish habitat are not expected from the road infrastructure (re-alignment and widening) once standard construction methods for culvert installation and mitigation strategies are implemented during road widening and re-alignment.

Migratory Birds

Mine site preparation may cause temporary and medium-term loss of habitat for birds and may cause disturbance or displacement of species. The widening of existing roads may cause a permanent loss of habitat for birds, and construction of new roads may affect habitat use by birds. Habitat fragmentation may alter habitat suitability for those species which rely on interior forest conditions. Within the haul road PA, this change in habitat is expected to be permanent.

Lights on the mine site may cause disturbance or displacement of species, while attracting other species, or may cause general behavioral changes (DaSilva, Valcu and Kempenaers, 2015). For those species which may be attracted to lights (i.e. insectivores), lights may increase potential for direct mortality of these species or may increase habitat suitability by supplementing their source of prey.

Increased truck and vehicular traffic will increase noise levels, which may displace and/or disturb birds. Heavy machinery operation during open pit development, road construction, and construction of mine infrastructure for crushing and hauling will increase dust emissions, which may affect surrounding vegetation and, consequently, birds (Farmer, 1993). Blasting and drilling of in-situ rock during open pit mining will increase dust emissions, which may affect surrounding vegetation and, consequently, birds (Farmer, 1993).

There is the potential for migratory bird mortality during clearing activities. Birds (particularly injured or fledgling) may get trapped in the open pit or collide with other Project infrastructure (crushers or trucks), which could lead to death or injury. Vehicle activity and heavy machinery operation may cause bird injury or mortality.

The overall effects of the Project on birds and bird habitat is assessed as not significant after mitigation measures have been implemented. Monitoring will be undertaken for the life of the Project.

Species at Risk

Three priority species have been identified or are expected to reside within watercourses in the PA (American eel, Atlantic salmon, and Blacknose dace). Although these species are not listed under provincial or federal endangered species legislation, DFO has indicated that they are currently being reviewed for protection under SARA. This is discussed further in the Fish and Fish Habitat section above. Standard mitigation and monitoring for fish and fish habitat (Section 6.6.7) will address direct and indirect effects to Atlantic salmon, Blacknose dace, and American eel.

Development of the mine footprint and upgrading and construction of new sections of the haul road will result in direct impacts to vascular and non-vascular individuals and to flora communities at the full or partial forest stand level.

Within the mine footprint PA, three of the seven documented locations of frosted glass whiskers (*Sclerophora peronella)* are expected to be directly impacted, along with two of the three locations of Wiegand's Sedge (*Carex wiegandii)*, and the single location of lesser rattlesnake plantain (*Goodyera repens)* by construction of the Waste Rock Storage Area. Three of the twenty-six observed locations of blue felt lichen (*Degelia plumbea*) may be directly impacted by construction of a water diversion ditch (north of the open pit), the pit perimeter berm around the open pit, and the till stockpile. The following species have been documented within close proximity to proposed infrastructure and may be indirectly impacted by development: frosted glass whiskers, *Sclerophora peronella* (4), blistered jellyskin lichen, *Leptogium corticola* (3), peppered moon lichen, *Sticta fuliginosa* (2), and Wiegands' sedge, *Carex wiegandii* (1).

Blue felt lichen, highbush blueberry, Appalachian polypody and southern twayblade are species of non-vascular and vascular flora which have been documented in the haul road PA. None of these individuals are found along the proposed alignment for the upgraded haul road or along the centerline of the section of new construction and an approximate 20 m buffer. While detailed design of the haul road layout is not yet complete, it is not anticipated that vascular or non-vascular flora priority species will be directly impacted by upgrading the existing road or by the construction of the new 4 km section of the haul road. As is possible, Atlantic Gold will work to avoid priority flora species during detailed Project design of the haul road upgrades. Within the mine footprint, micro-siting of infrastructure has been completed to avoid priority flora species wherever possible.

Indirect effects to habitat and flora described in Section 6.7 are relevant to priority flora species as well. Lichens are sensitive to changing environmental conditions, particularly air quality. As such, Project activities may indirectly affect priority lichen species which have been avoided, but exist in close proximity to Project infrastructure.

Terrestrial fauna priority SAR/SOCI observed during field surveys within the PA includes the mainland moose and the snapping Turtle.

Development of the mine and associated upgrades to the haul road will cause direct impacts to habitat used by terrestrial fauna, including wetlands with suitable hibernacula for snapping turtles, and those with abundant submergent and emergent vegetation for mainland moose. Sensory disturbance to terrestrial fauna would result from rock blasting (1-2 times per week during operation), clearing and grubbing, infrastructure construction during the construction phase and, overall increased traffic, blasting, mining activities and trucking during operations within the PA. This would likely result in localized wildlife avoidance of the PA, including moose and snapping turtle. Direct mortality of priority fauna species could result from Project activities, particularly due to the increase in traffic during construction and operation of the facility. Increased traffic poses a risk to wildlife such as the mainland moose and snapping turtle along the entire length of the haul road between the Beaver Dam mine and the Touquoy processing facility. Indirect mortality to these species could also occur from exposure to contaminants or spills from unplanned incidents.

With appropriate mitigation and monitoring, no direct mortality of priority bird species is anticipated, with the exception of the low potential for a bird strike with a haul truck. Avian usage of the PA during construction and operation of the Beaver Dam Mine will largely be driven by changes to habitat, resulting in localized avoidance of the PA by some species. Some priority species may avoid the PA in favor of undisturbed habitat in the surrounding landscape. Other priority species are anticipated to be attracted to the mine infrastructure and newly created habitat.

Most direct and indirect impacts on birds, including SAR, are accounted for in general mitigation/monitoring for all birds, since many have legislated protection under the Migratory Birds

Convention Act (primarily through avoiding clearing/grubbing during nesting season, and conducting detailed pre-construction nest searches if clearing or grubbing must occur during nesting season). These pre-construction nest searches are particularly important in wetlands which provide suitable breeding habitat for the Olive-sided Flycatcher, Canada Warbler and Rusty Blackbird.

6.14.2 Environmental Effects on Federal or Transboundary Lands

There are no federal or transboundary lands located within or adjacent to the PA. Given the distance from the Project site to federal lands and the analysis completed in Section 6, the Project has limited potential to result in a change to the environment on federal lands. The nearest federal lands to the PA are the Beaver Lake IR 17, located approximately 5 km from the mine site and 3 km from the nearest point of the haul road. This is discussed further in the following section.

6.14.3 Environmental Effects on Indigenous Peoples

Beaver Lake IR 17 is located approximately 5 km from the mine site and 3 km from the nearest point of the haul road. A MEKS was undertaken in 2015 to characterize past and present traditional use of the PA. Based on the findings presented in the MEKS report, the evaluation of potential pathways and interactions described in Section 6.11.6, and findings obtained during site visits, it is concluded that there is currently no direct Mi'kmaq use of the Project site for subsistence harvesting of food, medical plants or hunting or furbearing animal harvesting. It is known that areas to the west of the site have traditionally been used for these and ceremonial (burial) activities. The potential Burial sites are not located within the proposed Project site and there is a low likelihood of pre-contact artifacts as per the archaeological study, therefore, a direct effect of the Project is not expected to be significant as per the MEKS.

The Mi'kmaq community continues to harvest plant species throughout Nova Scotia and the area around the Project Mine site is no exception. Harvesting of trees and plants such as maple, ash, and birch for tools and crafts continue wherever these resources are known to occur. This is also true for blueberries, cranberries, strawberries and fox berries. The MEKS also noted that several species of medicinal plants continue to be collected in the region. While plant species of significance to Mi'kmaq were identified within the MEKS study area, these same species also exist within the surrounding area. While the destruction of some specimens is a Project effect, it does not pose a threat to Mi'kmaq use of the species; therefore, permanent loss of some specimens of plant species of significance to Mi'kmaq is not expected to be significant as per the MEKS. Based on the relatively small footprint of the Project, existing disturbance in the Project Area, and proposed mitigation, monitoring, and follow up associated with other VCs, the direct effects of the Project on hunting, gathering and trapping activities is expected to be minimal.

Under the circumstances described above, changes to the environment caused by the Project are not likely to directly affect the current use of lands and resources for Mi'kmaq purposes. While there are no expected indirect effects on the Mi'kmaq of Nova Scotia based on the effects assessment of the other VCs, this is based on the implementation of the mitigation and monitoring proposed for these other VCs as outlined in this EIS.

6.14.4 Power or Duty by Federal Authority

Should the Project require a federal authority to exercise a power or perform a duty, Section 5(2)(b) of CEAA, 2012 requires the following environmental effects to be considered:

(a) a change, other than those referred to in paragraphs (1)(a) and (b) [of Section 5, CEAA 2012], that may be caused to the environment and that is directly linked or necessarily incidental to a federal authority's exercise of a power or performance of a duty or function that would permit the carrying out, in whole or in part, of the physical activity, the designated Project or the Project; and

(b) an effect, other than those already described related to aboriginal peoples, of any change referred to in paragraph (a) on

  (i) health and socio-economic conditions,

  (ii) physical and cultural heritage, or

  (iii) any structure, site or thing that is of historical, archaeological, paleontological or architectural significance.

Any physical activities in wetlands, watercourses or waterbodies may require authorization in accordance with the Fisheries Act. A significant adverse effect from the Project on fish and fish habitat is defined as an effect that is likely to cause serious harm to fish. An adverse effect that does not cause a permanent loss to fish or fish habitat is considered to be not significant and therefore would not likely require a Fisheries Act Authorization. An adverse effect that does cause a permanent loss to fish habitat may be mitigated by replacement of lost habitat and removal/rescue of fish present prior to commencement of the activity. This completion of compensation and fish rescue may also allow for an adverse effect to be considered not significant. In this way, a Fisheries Act Authorization may not be required.

For the Beaver Dam Mine Project, within the mine footprint, the Project Team has conservatively calculated a maximum loss of 81,585.3 m^2 of fish habitat to support the mine development (direct impact to confirmed fish habitat based on watercourse and wetland characterization, electrofishing and manual fish collection results). An additional 107,612.66 m^2 of potential fish habitat is also expected to be lost to support the mine development (direct impact to potential fish habitat based on watercourse and wetland characterization, electrofishing and manual fish collection results). Minimal loss of confirmed or potential fish habitat is expected to support the haul road upgrade and new construction where necessary. Five watercourses along the haul road will be affected by upgrade activities that are not currently designed to be perpendicular to the proposed upgraded road. A total of 211.5 m^2 of watercourse habitat that is potential or confirmed fish habitat will be lost to support road upgrades. Additionally, nine wetlands that are confirmed to, or potentially support fish and fish habitat, will be impacted by haul road upgrade activities totaling 4029.2 m^2 of wetland habitat.

There is also potential for indirect impacts to additional fish habitat surrounding the mine development and upgraded haul road. However, with proper mitigation techniques employed, the likelihood of this occurring is low, and with proposed monitoring programs implemented, even if impacts occurred, they would be identified quickly, and thus, would not likely alone trigger serious harm to fish and a Fisheries Act Authorization.

The predicted residual environmental effects of Project development, operations and decommissioning on fish and fish habitat are determined to be present. The overall residual effect of the Project on fish and fish habitat is assessed as not significant after mitigation measures have been implemented. Whether these residual environmental effects will require a Fisheries Act Authorization will be determined during future permitting stages of this project. During permitting, detailed design will focus on reduction of impact to fisheries resources as much as is possible. A Fisheries Act Authorization has been determined possible, based on confirmed direct impacts to fish and fish habitat associated with the mine development infrastructure, and to a much lesser degree, the upgrade and new construction associated with the haul road.

6.14.5 Environmental Effects Incidental of Decisions Made by a Federal Authority

Section 5(2)(b) of CEAA, 2012 identifies that if the Project requires a federal authority to exercise a power or perform a duty or function required by an Act to allow the Project to proceed, environmental effects must be taken into account, including effects on the following:

(i) Health and socio-economic conditions

(ii) Physical and cultural heritage, or

(iii) Any structure, site or thing that is of historical, archaeological, paleontological or architectural significance.

As a result of the predicted residual environmental effects on fish and fish habitat, associated changes to the environment are described in accordance with 5(2) of CEAA 2012. The following table described the linkages to relevant VCs (if any), where the related effects assessment is present within the EIS, and additional effects assessment, if necessary.

Table 6.14-1 Linkages to Environmental Effects Assessment for Relevant VCs

Federal Permit/Decision Required	Beaver Dam Project Component(s)	Linkage to other Valued Component (VCs)	Effects Evaluation Location in EIS	Additional Evaluation Needed
Fisheries Act Authorization	Waste Rock Pile, Stockpiles and Open Pit within mine footprint. Limited potential from haul road upgrades and new construction	Wetlands	Section 6.5.6	none
		Surface Water	Section 6.3.6	none
		Groundwater	Section 6.4.6	none
		Habitat/Flora	Section 6.7.6	none
		Fauna	Section 6.8.6	none
		Birds	Section 6.9.6	none
		Species at Risk	Section 6.10.6	none

The mine footprint project area is currently accessible to humans with a network of existing forestry access roads, and small truck/ATV trails. A cabin is present on the northeastern shore of Crusher Lake. The land is privately owned by Northern Timber. Forestry activity surrounding the PA is significant and the Project Area is located in a remote location without any significant human settlement/town/village/city. Therefore, although access is reasonable into the PA, human traffic into the area for recreational opportunities like hunting, fishing and hiking is limited, and surrounding forestry activity and private ownership limit human recreational opportunities.

Loss of fish habitat within the mine footprint will result from the development of the open pit, waste rock pile and other associated stockpiles. First order stream habitat and associated headwater and through-flow wetland habitat will be lost to support the development of the mine. Stream habitat lost will be Type II or IV fish habitat that primarily support feeding, passage and refuge for fish. Some stream habitat was observed to be deep enough to potentially support overwintering for fish populations. However, these streams are not large river systems and are not quality commercial or aboriginal fishing locations. As a result, the potential effect of a Fisheries Act Authorization on non-Aboriginal health and socio-economic conditions (e.g. reduction of fishing activity) is expected to be very low due to the loss of fish habitat associated with the mine development.

Fish habitat loss via wetland alteration within the mine footprint will also result from the development of the open pit, waste rock pile and other associated stockpiles. Wetland habitat that will be altered has been determined to support passage for fish, refuge habitat for fish, and feeding habitat for fish. Several wetlands also have sufficient depth to potentially support overwintering populations of fish. These wetland habitats do provide some hiking, berry picking, bird watching, hunting and recreational opportunities, but provide limited to no fishing opportunities. As a result, the potential effect of a Fisheries Act Authorization on non-Aboriginal health and socio-economic conditions (e.g. reduction of hiking, hunting, and fishing activity) is expected to be very low due to the loss of fish habitat associated with the mine development.

6.15 Accidents and Malfunctions

Accidents and malfunctions refer to events that are not part of any activity or normal operation of the Project as has been planned by Atlantic Gold. Even with the implementation of best management practices and preventative measures, accidents and malfunctions still have the potential to occur and create adverse effects to the environment and worker health and safety. Many accidents and malfunctions are preventable and their consequences severely limited by applying the precautionary approach during planning and design, developing thorough emergency response procedures, and ensuring mitigation measures are incorporated into standard operating procedures. By identifying likely worst-case accidents and malfunctions and assessing their effects should they occur, Atlantic Gold can develop preventative and responsive procedures to eliminate, reduce, or control adverse effects caused by accidents and malfunctions. Preventative and responsive procedures will be developed via the following principles:

- best management practices and innovative technologies will be utilized to undertake the Project and all releases to the environment and their effects will be controlled;
- worker health and safety will be the centre focus of process and mine safety management;
- develop and apply procedures and training that will aim to promote safe operation of mining equipment and facilities; and

- develop and implement emergency response procedures that will reduce and control the adverse effects of an accident and malfunction.

The Project will be designed to implement preventative and mitigation procedures throughout its entire life that will minimize the potential for accidents and malfunctions to occur. Should those accidents or malfunctions occur, emergency response procedures would be implemented to eliminate, reduce, or control the resulting adverse effects.

6.15.1 Assessment Methodology

The assessment of effects from potential accidents and malfunctions were assessed based on a reasonable worst-case scenario, which employs a risk based approach that involves identifying hazards associated with Project infrastructure and activities, as well as the consequences should those hazards create an accident and malfunction. The identification of hazards was completed utilizing the experience of the EA Study Team and consulting other projects similar to the Beaver Dam Mine Project. The identification of worst-case scenarios/consequences were determined using a qualitative risk assessment to determine the likelihood that hazards would create an accident and malfunction, and determining the level of magnitude of those accidents and malfunctions should they occur.

Accidents and malfunctions that are considered either likely to occur, or have a significant effect should they occur are included in this assessment. For each potential accident and malfunction, the following details will shape the effects assessment:

- a threshold for determination of significance is provided to set a benchmark for significance of an accident and malfunction;
- the interactions between the accident and malfunctions and specific VCs and the resulting effects are discussed in reference to their significance;
- mitigation measures are presented and designed to prevent the occurrence of accidents and malfunctions; and
- preliminary emergency response measures are discussed to lessen the magnitude of accidents and malfunctions should they occur.

Accidents and malfunctions have the potential to occur through every phase of the Project. In order to decrease the likelihood of occurrence and level of magnitude should these accidents and malfunctions occur, Atlantic Gold will implement a preventative system approach to environmental protection and worker and health and safety. Contractors will be subject to the same health, safety, and environment policies and procedures, and all personnel will receive site specific training to prevent and mitigate accidents and malfunctions. The Environmental Management System and Health and Safety Plans under development at the Touquoy Gold Project will extend to the activities in all phases of the Beaver Dam Mine Project. These plans will be examined and refined where needed to reflect BMP prior to the time that the Beaver Dam ore is processed at the Touquoy facility.

6.15.2 Hazard Identification

Nearly all Project components and activities outlined in Sections 2.2 and 2.3 of this EIS have the potential to create accidents and malfunctions give ideal conditions; however, the likelihood is often extremely low. Those hazards considered to have the greatest likelihood to create an accident and malfunction, or have a significant effect should those accidents and malfunctions occur are outlined by phase in Table 6.15-1.

Table 6.15-1 Summary of Potential Accidents and Malfunctions

Hazard Categories	Potential Accidents and Malfunctions Scenarios	Site Preparation and Construction	Operation and Maintenance	Decommissioning and Reclamation
Structural Failures	Surface Mine Slope Failure	○	●	○
	Stockpile Slope Failure	○	●	○
	Settling Pond Failure	○	●	○
	Infrastructure Failure	○	●	○
Accidents	Fuel and/or Other Spills	●	●	○
	Unplanned Explosive Event	○	●	-
	Mobile Equipment Accident	●	●	○
Other Accidents and Malfunctions	Forest and/or Site Fires	●	●	○

Legend

Potential for Adverse Effects

● High potential for adverse effects

○ Low potential for adverse effects

6.15.3 Structural Failures

6.15.3.1 Surface Mine Slope Failure

All phases of the Project have the potential for structural failures of slopes within the footprint of the surface mine. The potential slope failures are as follows:

- failure of overburden slopes caused by erosion from vegetation stripping and surface water runoff; and
- failure of bedrock faces caused by improperly designed benches and erosion/fracturing from groundwater inflow.

A worst-case scenario is the severe collapse of areas directly adjacent to the open pit and ground surface slump of the surrounding area possibly affecting the site’s infrastructure, haul roads, and on-site access roads and worker safety. However, the site's components and infrastructure have been designed as far from the perimeter of the open pit as possible so it is not expected that slope failure would affect the site's components and infrastructure.

During the initial stages of site preparation and construction, potential slope failures caused by erosion from vegetation stripping and surface water runoff will be limited to overburden; however, as blasting, and ore and non-ore bearing waste rock extraction commences, bedrock faces have the potential to fail if not properly designed and groundwater inflow is not properly managed. Based on the current delineation of ore, the surface mine will be excavated through bedrock to an end depth of approximately 170 m below ground surface. Bench heights of 10 m are designed with 8 m wide berms placed every two benches. Bench face angles prescribed by a geotechnical study will be implemented for specific depths and zones of the surface mine.

Geotechnical work has been completed at the Touquoy site and the expertise gained from working with these materials will be applied to the final design of the Beaver Dam disturbed areas using actual geotechnical data collected at Beaver Dam to supplement the abundant public information available. The soil and bedrock at the site are well understood from a geotechnical and construction standpoint including extreme conditions such as drought, freeze-thaw cycles, and weather (high rainfall events or storm events and wind). All of these "extreme" factors have been accounted for in the design of the Project and will be for all phases of the Project. Features constructed from site materials such as waste rock stockpiles and overburden stockpiles will use the collected data for final design to produce features with appropriate safety factors to reduce the possibility of landslides, slope erosion and subsidence. With many stockpiles it is common to have subsidence in the short term creating a landscape that is varied in topography that is in line with NSDNR objectives for reclamation to have surfaces that are not uniform but offer safe long term landscapes with a variety of features. General reclamation goals to have heterogeneous landscapes that offer habitat features greater than simply a hydro seeded mat are important and can be assisted by some variation in the topography through subsidence.

Surficial geology in the area is described as stony till plains and drumlins with minor organic deposits. Till is typically 2-20 m thick and primarily comprised of a stony and sandy matrix material derived from local bedrock sources, while drumlin facies are typically 4-30 m thick and siltier due to erosion and incorporation of older till units by glaciers.

Threshold for Determination of Significance

The criteria that would determine a significant effect should an overburden or bedrock slope fail, is based primarily on worker health and safety, and secondarily on property damage. Should a slope failure result in injury or death to a worker, or loss of mobile equipment the event will be considered significant.

Potential Interactions and Effects

The potential interactions between a surface mine slope failure and VCs is outlined in Tables 5.7-1 to 5.7-3. Additional detail by VC is outlined in Table 6.15-2. Only those interactions with a high potential to cause adverse effects should they occur are discussed in detail.

Table 6.15-2 Surface Mine Slope Failure Interactions with VCs

Valued Component	Potential Surface Mine Slope Failure and VC Interaction	Potential for Adverse Effects
Atmospheric Environment	• Failure of overburden slopes could potentially cause temporary suspension of dust	Low
Geology, Soil, and Sediment Quality	• No potential interaction anticipated	-
Surface Water Quality and Quantity	• No potential interaction anticipated	-
Groundwater Quality and Quantity	• No potential interaction anticipated	-
Wetlands	• No potential interaction anticipated	-
Fish and Fish Habitat	• No potential interaction anticipated	-
Habitat and Flora	• No potential interaction anticipated	-
Birds	• No potential interaction anticipated	-
Fauna	• No potential interaction anticipated	-
Species of Conservation Interest and Species at Risk	• No potential interaction anticipated	-
Indigenous Peoples	• No potential interaction anticipated	-
Physical and Cultural Heritage	• Failure of overburden slopes could potentially cause destruction of archaeological, historical, and paleontological sites	Low
Human Health and Socio-economic Considerations	• Failure of overburden slopes and bed rock faces could potentially cause injury or death to mine workers	High

Dust suspended from the failure of a surface mine slope would be temporary and localized to the area directly around the slope failure. In addition, the physical and cultural heritage artifacts in the area of any surface mine slope failure are likely to be identified during mine development. As a result, potentially adverse effects to the atmospheric environment and physical and cultural heritage are considered low.

Surface mines with improperly designed benches and slopes and poor surface water and groundwater management pose a health and safety risk to workers during the site preparation and construction, and operation and maintenance phases, as well as a financial liability risk related to mobile equipment damage or loss.

The maximum effect of an overburden or bedrock face slope failure as it relates to worker health and safety would be a death caused by falling objects. The maximum effect of an overburden or bedrock face slope failure as it relates to financial lability would a total loss of one or more pieces of mobile equipment.

Given proper surface mine design, and surface water and groundwater management, overburden or bedrock face slope failure is most likely to occur during the decommissioning and reclamation phase of the Project when the surface mine is allowed to infill via surface water runoff and groundwater inflow. Surface water runoff may erode overburden to a point of failure, while groundwater inflow may weaken major bedrock joints or discontinuities and cause a failure. Fortunately, this reclamation activity is passive and will not involve direct interaction between workers and slopes.

Given a lack of environmental receptors in the surface mine and that all effects from a slope failure will be contained to the surface mine, potential adverse effects to other VCs from an overburden slope failure or bedrock face failure are anticipated to be non-existent.

Mitigation and Emergency Response

Regional and site specific drilling has encountered bedrock materials that consist mainly of metamorphosed sedimentary rocks of the Goldenville Group. These materials are very stable and widely used in Nova Scotia for road materials and situations where erosion resistant materials are needed. Abundant highway construction projects leave these strata at vertical or near vertical with limited issues of stability.

A daily inspection of pit slopes by qualified personnel will be undertaken for any work area within the pit prior to employees or machinery entering. It is proposed to have an independent consultant review slopes on a quarterly basis. Pit slopes are based on recommendations of independent expert with appropriate design safety factors applied. Slopes will be monitored throughout the life of the operation.

A berm surrounding the surface mine will direct surface water runoff into a water diversion channel that discharges to the settling pond to the west. The berm will be keyed into the bedrock to prevent shallow groundwater flow and/or surface water originating in Cameron Flowage from entering the surface mine. An in-mine water diversion ditch will be established along the top bench of the mine to intercept any surface water that infiltrates the berm and flows into the mine. This ditch will direct water to in-mine sumps where it will be pumped out of the mine.

Based on the current delineation of ore, the surface mine will be excavated through bedrock to an end depth of approximately 170 m below ground surface. Bench heights and bench face angles prescribed by a geotechnical study (O’Bryan et. al., 2015) will be implemented for specific depths and zones of the surface mine.

If slope failure were to occur, emergency procedures would be implemented that will be outlined in the site emergency response plan. Generally slope failure emergency response includes evacuation of all equipment and personnel from the area and areas up-slope and down-slope from the slope failure area. An assessment is then made using on-site staff and possibly external resources (geotechnical specialists) to make a determination if the area can be accessed to make repairs, what repairs are needed and actions to prevent future incidents. Depending on the regulator involvement there may be a requirement to file incident reports with certain regulatory agencies prior to initiating the repairs and return to work in the area; these are very case specific and often dependent on whether personnel were injured or equipment damaged as a result of the slope failure.

6.15.3.2 Stockpile Slope Failure

All phases of the Project have the potential for structural failures of topsoil, till, and waste rock stockpile slopes. Failure of these slopes may be caused by improperly designed lifts, and erosion from surface water runoff.

Worst-case scenario resulting from stockpile slope failure would be disturbance to surrounding area, including the potential for mine rock and low-grade ore to enter nearby watercourses, damage to infrastructure and worker safety. As discussed below, stockpiles will be constructed in a way to reduce the consequences of the worst-case scenarios.

Topsoil stockpiles will be constructed to completion in single lifts of 10 m with 1.5:1 active slopes during the preparation and construction phase. They will be removed through use in progressive reclamation of the till and waste rock stockpiles during operation and maintenance and will have no significant presence prior to or shortly after decommissioning and reclamation commences.

Till stockpiles will be constructed to completion in single lifts of 15 m with 1.5:1 active slopes during the preparation and construction phase. They will be progressively capped with topsoil excavated from the surface mine area and hydro seeded at the end of operations. This should allow for revegetation to being prior to or shortly after the decommissioning and reclamation commences.

The waste rock stockpile will be constructed in multiple lifts of 10m with each lift having an active slope of 2:1. It will begin construction during the site preparation and construction phase and being completed prior to or shortly after the decommissioning and reclamation phase commences. The waste rock stockpile will be progressively capped with topsoil excavated from the surface mine area and hydro seeded during the decommissioning and reclamation phase.

Ore stockpiles will be constructed in 15 m lifts with 1.5:1 active slopes during the operation and maintenance phase. High grade ore will be stockpiled near the crusher on the ROM and facilities pad and continually added to by mine trucks and subtracted from by front end loaders. Low grade ore will be stockpiled east of this area and will remain until near the end of the operation and maintenance phase. All ore stockpiles will be removed prior to the decommissioning and reclamation phase.

Threshold for Determination of Significance

The criteria that would determine a significant effect should a stockpile slope fail, is based primarily on worker health and safety, and secondarily on property damage and environmental effects. Should a slope failure result in injury or death to a worker, a loss of mobile equipment, or a release of low pH surface water to the environment the event will be considered significant.

Potential Interactions and Effects

The potential interactions between a stockpile slope failure and the VCs are outlined in Tables 5.7-1 to 5.7-3. Additional detail by VC is outlined in Table 6.15-3. Only those interactions with a high potential to cause adverse effects should they occur are discussed in detail.

Table 6.15-3 Stockpile Slope Failure Interactions with VCs

Valued Component	Potential Stockpile Slope Failure and VC Interaction	Potential for Adverse Effects
Atmospheric Environment	• Failure of stockpile slopes could potentially cause temporary suspension of dust	Low
Geology, Soil, and Sediment Quality	• Failure of waste rock stockpile slopes could potentially cause ARD production and discharge to settling ponds	Low
Surface Water Quality and Quantity	• Failure of waste rock stockpile slopes could potentially cause ARD production and discharge to settling ponds	Low
Groundwater Quality and Quantity	• No potential interaction anticipated	-
Wetlands	• Failure of waste rock stockpile slopes could potentially cause ARD production and discharge to settling ponds	Low
Fish and Fish Habitat	• Failure of waste rock stockpile slopes could potentially cause ARD production and discharge to settling ponds	Low
Habitat and Flora	• No potential interaction anticipated	-
Birds	• No potential interaction anticipated	-
Fauna	• No potential interaction anticipated	-
Species of Conservation Interest and Species at Risk	• No potential interaction anticipated	-
Indigenous Peoples	• No potential interaction anticipated	-
Physical and Cultural Heritage	• No potential interaction anticipated	-
Human Health and Socio-economic Considerations	• Failure of stockpile slopes could potentially cause injury or death to mine workers	High

Dust suspended from the failure of a stockpile slope would be temporary and localized to the area directly around the slope failure. In addition, production and discharge of ARD to receiving watercourses in the area is unlikely due to all surface water runoff being directed to settling ponds for treatment and monitoring prior to discharge to the environment. As a result, potentially adverse effects to the atmospheric environment, geology, soil, and sediment, surface water quality and quantity, wetlands, and fish and fish habitat are considered low.

Improperly designed stockpiles with poor surface water management pose a health and safety risk to workers and a financial liability risk related to mobile equipment damage or loss through all phases of the Project.

The maximum effect of a stockpile slope failure as it relates to worker health and safety would be a death caused by falling objects. The maximum effect of a stockpile slope failure as it relates to financial lability would a total loss of one or more pieces of mobile equipment.

Given proper stockpile design and surface water management, as well as progressive reclamation practices for the till and waste rock stockpiles, stockpile slope failure is most likely to occur during the operation and maintenance phase of the Project when stockpiles are being continually acted upon either through loading, unloading, or shaping of material. Surface water runoff may erode topsoil, till, and waste rock to a point of failure as well.

Given surface water runoff from all stockpiles is directed to settling ponds for treatment and a slope failure would likely not result in disturbance to a greenfield environment, potential adverse effects to other VCs from a stockpile slope failure are anticipated to be non-existent.

Mitigation and Emergency Response

Slopes will be designed at an angle determined by geotechnical analysis and acceptable safety factors, thereby reducing the likelihood of a slope failure. Placement of materials in the stockpiles would follow a plan developed for the stockpile that would consider thickness of the lift, compaction – if needed, load size, start and stockpile physical limits. Slopes will be monitored throughout the life of the operation with routine inspections by qualified staff and repairs made if warranted.

Surface water run-off from the non-ore bearing waste rock stockpile, mine site roads, and till stockpiles will flow by gravity, with the aid of berms and channels, to a settling pond located west of the surface mine. Water will be gradually decanted to Cameron Flowage by gravity via a water diversion structure that runs northeast from the settling pond.

If slope failure were to occur, emergency procedures would be implemented that will be outlined in the site emergency response plan. Generally slope failure emergency response includes evacuation of all equipment and personnel from the area and areas up-slope and down-slope from the slope failure area. An assessment is then made using on-site staff and possibly external resources (geotechnical specialists) to make a determination if the area can be accessed to make repairs, what repairs are needed and actions to prevent suture incidents. Depending on the regulator involvement there may be a requirement to file incident reports with certain regulatory agencies prior to initiating the repairs and return to work in the area, these are very case specific and often dependent on whether personnel were injured or equipment damaged as a result of the slope failure.

6.15.3.3 Settling Pond Failure

All phases of the Project have the potential for a settling pond failure. A failure of the settling pond is defined as a breach of the banks through overflow or bank structure failure resulting in the release of sediment laden water to the environment. A worst-case scenario would be complete failure of the settling pond, resulting in uncontrolled discharge of sediment laden water into the surrounding environment. The capacity demand of the settling pond will increase as surface mine depth increases and more infiltrated groundwater is pumped out of the mine.

Surface water run-off from the non-ore bearing waste rock stockpile, mine site roads, topsoil stockpiles, and till stockpiles will flow by gravity, with the aid of berms and channels, to a settling pond located west of the surface mine. This settling pond will also receive water from the surface mine dewatering program. Treatment of surface water runoff and mine infiltration groundwater will be passive. Water will eventually decant to Cameron Flowage through a fringe wetland and by gravity via a water diversion structure that runs northeast from the settling pond.

Surface run-off water from the Beaver Dam mine site ROM and facilities pad will flow by gravity, with the aid of berms and channels, to a collection pond located between the crushing operation and water storage tanks. A culvert located beneath the mine entrance road will facilitate decant overflow from the pond to a water diversion structure that splits the two ore stockpiles. The water diversion structure will discharge to a channel that will run down gradient to the northeast and ultimately discharge to Cameron Flowage. The discharge point will be equipped with a concrete flow-control structure with the ability to be shutoff allowing no flow to leave if needed.

The final design of the settling pond, collection pond, and additional required water management measures will be submitted as part of the IA process.

In the event of a 1 in 100 year precipitation event, which in Nova Scotia is identified as approximately 115 mm in a 24 hour storm, a spillway into the water diversion structure will be used for overflow. In the case of a storm event or infrastructure failure, settling ponds will be monitored regularly.

Threshold for Determination of Significance

The criteria that would determine a significant effect should a settling pond fail, is based primarily on environmental protection. Should a settling pond failure result in an uncontrolled discharge of sediment laden water to Cameron Flowage the event will be considered significant.

Comparison of surface water samples to CCME FWAL TSS guidelines and MMER TSS guidelines will be utilized to determine if sediment laden water will have an impact on surface water quality in Cameron Flowage and subsequently on fish and fish habitat.

Potential Interactions and Effects

The potential interactions between settling pond failure and the VCs are outlined in Tables 5.7-1 to 5.7-3. Additional detail by VC is outlined in Table 6.15-4. Only those interactions with a high potential to cause adverse effects should they occur are discussed in detail.

Table 6.15-4 Settling Pond Failure Interactions with VCs

Valued Component	Potential Settling Pond Failure and VC Interaction	Potential for Adverse Effects
Atmospheric Environment	• No potential interaction anticipated	-
Geology, Soil, and Sediment Quality	• Failure of settling pond could potentially cause contaminated suspended solids to settle in Cameron Flowage and effect sediment quality	Low
Surface Water Quality and Quantity	• Failure of settling pond could potentially cause sediment laden water to discharge to Cameron Flowage via the fringe wetland around Mud Lake	High
Groundwater Quality and Quantity	• No potential interaction anticipated	-
Wetlands	• Failure of settling pond could potentially cause sediment laden water to	High

Table 6.15-4 Settling Pond Failure Interactions with VCs

Valued Component	Potential Settling Pond Failure and VC Interaction	Potential for Adverse Effects
	discharge to fringe wetlands around Mud Lake	
Fish and Fish Habitat	• Failure of settling pond could potentially cause sediment laden water to discharge to Cameron Flowage via the fringe wetland around Mud Lake	High
Habitat and Flora	• No potential interaction anticipated	-
Birds	• No potential interaction anticipated	-
Fauna	• No potential interaction anticipated	-
Species of Conservation Interest and Species at Risk	• Failure of settling pond could potentially cause sediment laden water to discharge to Cameron Flowage via the fringe wetland around Mud Lake	High
Indigenous Peoples	• No potential interaction anticipated	-
Physical and Cultural Heritage	• No potential interaction anticipated	-
Human Health and Socio-economic Considerations	• No potential interaction anticipated	-

The degree to which suspended solids are expected to settle out of solution in a concentrated area should a settling pond failure occur is considered minimal. As a result, potentially adverse effects to the sediment quality portion of the geology, soil, and sediment quality VC are considered low.

Inadequate settling pond capacity and water level monitoring, combined with a significant precipitation event may cause a settling pond failure and thus, pose a risk to surface water quality, wetlands, fish and fish habitat, and SOCI/SAR through all phases of the Project.

The maximum effect of a settling pond failure as it relates to VCs above would be heavy siltation of wetlands and Cameron Flowage and subsequent stresses on fish and other aquatic species.

Given inputs for the settling pond originate partially from the surface mine dewatering program, settling pond failure is more likely to occur as development of the surface mine progresses. Extracting waste rock and ore from the surface mine will increase the potential for groundwater infiltration, thus increasing the amount of water that needs to be pumped from the surface mine to the settling pond. As a result, the capacity requirements of the settling pond will increase the further the surface mine is advanced and the potential for settling pond failure through bank overflow and structure failure increases as well.

Given the settling pond is a passive treatment process and it will not provide habitat for terrestrial species, adverse effects to other VCs from a settling pond failure are anticipated to be non-existent.

Mitigation and Emergency Response

The water diversion structure leading from the collection pond will discharge to a channel that will run down-gradient to the northeast and ultimately discharge to Cameron Flowage. The discharge point will be equipped with a concrete flow-control structure. Sediment laden water from the settling pond will be gradually decanted to Cameron Flowage via a water diversion structure that runs northeast from the settling pond.

The settling pond will be lined with suitable materials, such as clay or a plastic liner. In the event of a 1 in 100 year precipitation event that creates volumes in excess of the capacity available in ponds and ditching, or infrastructure failure, a spillway into the water diversion structure will be used for overflow. In the case of a storm event or infrastructure failure, settling ponds will be monitored regularly.

6.15.3.4 Infrastructure Failure

All phases of the Project have the potential for failures of infrastructure. Failure of these structures may be caused by improper design and construction, or natural causes such as hurricanes or earthquakes. A worst-case scenario would be failure of multiple operational components as a result of a natural cause impacting worker health and safety and the surrounding environment. The following operational facilities will be installed or constructed to support the Beaver Dam Mine Project:

- crusher and conveyors;
- underground septic tanks and leach drains;
- raw water and potable water tank;
- diesel fuel storage and distribution system;
- skid-mounted diesel generators and power distribution overhead transmission lines;
- pole mounted lighting;
- vehicle washdown facility;
- pre-fabricated office facility and workshop building; and
- fire protection systems.

All infrastructure will be located on a central operational and ROM facilities pad that will provide quick access to the haul road and surface mine. These components are described in detail in Section 2.2.1 of this EIS.

Threshold for Determination of Significance

The criteria that would determine a significant effect should an infrastructure failure occur is based primarily on worker health and safety and secondarily on property damage. Should an infrastructure failure result in injury or death to a worker or a loss of infrastructure the event will be considered significant.

Should an infrastructure failure event result in the loss of any quantity of fuel, oil, lubricant, or other Project related raw materials to the environment such that a measureable contamination of soil, surface water, or groundwater results, the event will be considered significant.

Contamination is defined as the following:

- Soil
  - when concentrations of any contaminant exceed the guidelines provided in the Nova Scotia Contaminated Sites Regulations – Tier 1 Environmental Quality Standards for Soil at a Non-potable Site, Section 1, Table 1B;
- Surface Water
  - when concentrations of any contaminant exceed the guidelines provided in the Nova Scotia Contaminated Sites Regulations – Tier 1 Environmental Quality Standards for the Protection of Freshwater Aquatic Life in Surface Water, Section 1, Table 3;
- Groundwater
  - when concentrations of any contaminant exceed the guidelines provided in the Nova Scotia Contaminated Sites Regulations – Tier 1 Environmental Quality Standards for Groundwater at a Non-potable Site, Section 1, Table 4.

Potential Interactions and Effects

The potential interactions between infrastructure failure and VCs are outlined in Tables 5.7-1 to 5.7-3. Additional detail by VC is outlined in Table 6.15-5. Only those interactions with a high potential to cause adverse effects should they occur are discussed in detail.

Table 6.15-5 Infrastructure Failure Interactions with VCs

Valued Component	Potential Infrastructure Failure and VC Interaction	Potential for Adverse Effects
Atmospheric Environment	• An infrastructure failure event could potentially cause a fuel oil spill or small fire and release particulate matter, carbon monoxide, sulphur dioxide, nitrous oxides, and volatile organic compounds to the atmosphere	Low
Geology, Soil, and Sediment Quality	• An infrastructure failure event could potentially cause a release of fuel oil to soil if released to the terrestrial environment	Low
Surface Water Quality and Quantity	• No potential interaction anticipated	-
Groundwater Quality and Quantity	• No potential interaction anticipated	-
Wetlands	• No potential interaction anticipated	-
Fish and Fish Habitat	• No potential interaction anticipated	-
Habitat and Flora	• No potential interaction anticipated	-
Birds	• No potential interaction anticipated	-
Fauna	• No potential interaction anticipated	-
Species of Conservation Interest and Species at Risk	• No potential interaction anticipated	-
Indigenous Peoples	• No potential interaction anticipated	-
Physical and Cultural Heritage	• No potential interaction anticipated	-

Valued Component	Potential Infrastructure Failure and VC Interaction	Potential for Adverse Effects
Human Health and Socio-economic Considerations	• Failure of infrastructure could potentially cause injury or death to mine workers	High

The emissions produced through volatilization of fuel oil or through a small fire from an infrastructure failure event would be temporary and localized to the area directly around the failure. In addition, a release of fuel oil, lubricants or other Project related raw materials would be minor in volume and likely contained and cleaned up prior to significantly effecting soil. As a result, potentially adverse effects to the atmospheric environment, and geology, soil, and sediment quality are considered low.

Infrastructure that is improperly designed and constructed poses a health and safety risk to workers during the site preparation and construction, and operation and maintenance phases, as well as a financial liability risk related to infrastructure damage or loss.

The maximum effect of an infrastructure failure as it relates to worker health and safety would be a death caused by falling objects or collapsing structures. The maximum effect of an infrastructure failure as it relates to financial lability would a total loss of one or more pieces of infrastructure.

Given proper design and construction of infrastructure, failure is most likely to occur during the operation and maintenance phase of the Project when infrastructure is being worn and torn through operational processes. Infrastructure with moving components, such as the crusher and conveyor, are more likely to fail than static infrastructure, such as the office and workshop facilities.

Given infrastructure failure would likely not result in disturbance to a greenfield environment, potential adverse effects to other VCs from an infrastructure failure occurrence are anticipated to be non-existent.

Mitigation and Emergency Response

Infrastructure at the Beaver Dam mine site will be minimal and given the short life of the Project, failure should not occur without being acted upon by extreme natural causes, such as a hurricane or earthquake, or human error.

On-site infrastructure would be informally inspected by site personnel for signs of premature failure through the normal course of the working shift. More rigorous inspection would occur with routine maintenance. Existing legislation is well established and understood by Atlantic Gold personnel through the development and future operation of the Touquoy Mine.

A Health and Safety Plan will be developed and implemented for the mine site, which will include evacuation procedures, proper housekeeping procedures for the storage and use of small equipment, and materials.

6.15.4 Accidents

6.15.4.1 Fuel and/or Other Spills

All phases of the Project have the potential for fuel and/or other spills to occur. The perceived risk of a spill is most logical during the operation and maintenance phase when the following is occurring at the Beaver Dam mine site:

- bulk storage of diesel fuel is present on-site;
- frequent transfer and handling of diesel fuel is occurring;
- mobile equipment is operating and being maintained; and
- waste fluids such as oils, lubricants, and antifreeze are produced.

The site preparation and construction, and decommissioning and reclamation phases of the Project will have reduced risk due to a number of these activities not yet occurring or ceasing once the operation and maintenance phase is over.

Spills associated with these activities may occur through failure of storage tanks, improper fuel transfer procedures, fuel/hydraulic line breaks or leaks, spillage or failure of storage containers, and/or mobile equipment and refueling truck accidents.

A worst-case scenario would be a transportation collision causing the entire amount of material being transported to be spilled into a water body. The effects of the spill would vary depending on the material spilled; diesel fuel and gasoline are toxic to aquatic life and would have the great impact to the environment.

Diesel fuel will be delivered to double-walled aboveground storage tanks via licensed tanker trucks and be used in all mobile equipment and to power on-site generators. Other petroleum based and non-petroleum based liquids will be used for equipment maintenance.

Diesel fuel and lubricant storage will be located near the primary crusher and a dedicated refueling truck will deliver these materials to the mine and maintenance mobile fleet, as well as diesel powered generators. The fleet of haul road trucks required to transport crushed ore from Beaver Dam to the process plant at Touquoy will be refueled at Beaver Dam as needed using the fuel and lube truck noted above.

Threshold for Determination of Significance

The criteria that would determine a significant effect should a fuel and/or other spill occurs is based primarily on environmental protection. Should a spill result in the loss of any quantity of fuel, oil, lubricant, or other Project related raw materials to the environment such that a measureable contamination of soil, surface water, or groundwater results, the event will be considered significant.

Contamination is defined as the following:

- Soil

- o when concentrations of any contaminant exceed the guidelines provided in the Nova Scotia Contaminated Sites Regulations – Tier 1 Environmental Quality Standards for Soil at a Non-potable Site, Section 1, Table 1B;

- Surface Water
  - o when concentrations of any contaminant exceed the guidelines provided in the Nova Scotia Contaminated Sites Regulations – Tier 1 Environmental Quality Standards for the Protection of Freshwater Aquatic Life in Surface Water, Section 1, Table 3;
- Groundwater
  - o when concentrations of any contaminant exceed the guidelines provided in the Nova Scotia Contaminated Sites Regulations – Tier 1 Environmental Quality Standards for Groundwater at a Non-potable Site, Section 1, Table 4.

Potential Interactions and Effects

The potential interactions between fuel and/or other spills and VCs are outlined in Tables 5.7-1 to 5.7-3. Additional detail by VC is outlined in Table 6.15-6. Only those interactions with a high potential to cause adverse effects should they occur are discussed in detail.

Table 6.15-6 Fuel and/or Other Spills Interactions with VCs

Valued Component	Potential Fuel and/or Other Spills and VC Interaction	Potential for Adverse Effects
Atmospheric Environment	• Fuel and/or other spills could potentially volatilize into the atmosphere	Low
Geology, Soil, and Sediment Quality	• Fuel and/or other spills could potentially contaminate bedrock and soil if released to the terrestrial environment • Fuel and/or other spills could potentially contaminate sediment if released to the aquatic environment along the haul road	High
Surface Water Quality and Quantity	• Fuel and/or other spills could potentially contaminate surface water if released to the aquatic environment along the haul road	High
Groundwater Quality and Quantity	• Fuel and/or other spills could potentially contaminate groundwater if released to the terrestrial environment and soil/bedrock conditions allow vertical migration	High
Wetlands	• Fuel and/or other spills could potentially contaminate wetlands if released to the terrestrial environment along the haul road	High
Fish and Fish Habitat	• Fuel and/or other spills could potentially adversely affect fish and fish habitat if	High

Valued Component	Potential Fuel and/or Other Spills and VC Interaction	Potential for Adverse Effects
	released to the aquatic environment along the haul road	
Habitat and Flora	• No potential interaction anticipated	-
Birds	• Fuel and/or other spills could potentially adversely affect birds	Low
Fauna	• Fuel and/or other spills could potentially adversely affect fauna	Low
Species of Conservation Interest and Species at Risk	• Fuel and/or other spills could potentially adversely affect species of conservation interest and species at risk if released to the terrestrial environment and/or aquatic environment along the haul road	High
Indigenous Peoples	• No potential interaction anticipated	-
Physical and Cultural Heritage	• No potential interaction anticipated	-
Human Health and Socio-economic Considerations	• No potential interaction anticipated	-

Volatilization of fuel oil and/or other substances should they be spilled would be localized to the area directly around the spill. In addition, only a minor portion of fuel oil, the most widely used substance for the Beaver Dam Mine Project, is considered volatile. Adverse effects to birds and fauna are considered low due to the developed nature and lack of habitat in areas (Beaver Dam mine site) considered being at the greatest risk for fuel and/or other spills. As a result, potentially adverse effects to the atmospheric environment, birds, and fauna are considered low.

Accidents that cause a fuel and/or other spill pose an environmental risk to the following VCs:

- geology, soil, and sediment;
- surface water quality and quantity;
- groundwater quality and quantity;
- wetlands;
- fish and fish habitat; and
- SOCI/SAR.

The greatest potential for a fuel and/or other spills to occur is during the site preparation and construction, and operation and maintenance phases when the greatest amount of fuel is being stored, handled, and transferred on-site.

Small spills like those seen due to improper transfer procedures during refueling of equipment will likely have negligible environmental effects, while larger spills like those seen due to equipment/storage tank failures and mobile equipment accidents may have significant environmental effects.

The location of the spill will also determine the magnitude of effects. A spill occurring within the Beaver Dam mine site boundaries is unlikely to cause significant environmental effects as the area will be largely devoid of ecological receptors and the presence of hundreds of workers will likely lead to quick and efficient containment and cleanup efforts. The primary receiver for spills in this area is the soil portion of the geology, soil, and sediment quality VC. Spills are unlikely to reach surface water, sediment, groundwater, wetlands, and fish habitat due to anticipated spill response times, as well as containment and cleanup efforts. A spill occurring due to an accident along the haul road may have more significant environmental effects if the accident occurs in close proximity to a watercourse or wetland. If not, the primary receiver for spills along the haul road is the soil portion of the geology, soil, and sediment quality VC.

Mitigation and Emergency Response

The source of greatest risk for potential spills and releases of diesel fuel relates to the improper execution of procedures for transfer and handling to and from stationary and mobile tankage. Other sources of potential spills and releases of diesel fuel relate to equipment failures, damage to storage or piping systems, mobile equipment accidents, and mobile refueling truck accidents. Releases of maintenance fluids pose a lesser risk in terms of magnitude, but can still occur due to equipment failures, damage to storage containers, and mobile equipment accidents. A release of these fluids may result in soil, groundwater, and/or surface water contamination that may adversely ecological receptors through absorption, and/or ingestion of contaminated media.

Preventative procedures will be undertaken and fuel storage and transfer areas will be designed to accommodate these procedures, such as limiting areas of fuel transfer. Staff will be trained in spill response measures and spill response kits will be accessible in areas of fuel transfer. A petroleum management plan and a spill response plan will be developed.

6.15.4.2 Unplanned Explosive Event

An unplanned explosive event is limited to the site preparation and construction, and operation and maintenance phases of the Project. The worst-case scenario would be bodily harm as a result of improperly handling explosives.

Explosives will be supplied by an off-site contractor and there will be no requirement for an on-site magazine.

Threshold for Determination of Significance

The criteria that would determine a significant effect should an unplanned explosive event occur is based primarily on worker health and safety and secondarily on property damage and environmental protection.

Should an unplanned explosive event result in injury or death to a worker or a loss of infrastructure or mobile equipment the event will be considered significant.

Should an unplanned explosive event result in the loss of any quantity of fuel, oil, lubricant, or other Project related raw materials to the environment such that a measureable contamination of soil, surface water, or groundwater results, the event will be considered significant.

Contamination is defined as the following:

- Soil
  - concentrations of any contaminant exceed the guidelines provided in the Nova Scotia Contaminated Sites Regulations – Tier 1 Environmental Quality Standards for Soil at a Non-potable Site, Section 1, Table 1B;
- Surface Water
  - concentrations of any contaminant exceed the guidelines provided in the Nova Scotia Contaminated Sites Regulations – Tier 1 Environmental Quality Standards for the Protection of Freshwater Aquatic Life in Surface Water, Section 1, Table 3;
- Groundwater
  - concentrations of any contaminant exceed the guidelines provided in the Nova Scotia Contaminated Sites Regulations – Tier 1 Environmental Quality Standards for Groundwater at a Non-potable Site, Section 1, Table 4.

Potential Interactions and Effects

The potential interactions between an unplanned explosive event and VCs are outlined in Tables 5.7-1 to 5.7-3. Additional detail by VC is outlined in Table 6.15-7. Only those interactions with a high potential to cause adverse effects should they occur are discussed in detail.

Table 6.15-7 Unplanned Explosive Event Interactions with VCs

Valued Component	Potential Unplanned Explosive Event and VC Interaction	Potential for Adverse Effects
Atmospheric Environment	• An unplanned explosive event could potentially cause suspension of dust particles into the atmosphere	Low
Geology, Soil, and Sediment Quality	• An unplanned explosive event could potentially cause a release of fuel oil and/or ammonium nitrate to soil	Low
Surface Water Quality and Quantity	• No potential interaction anticipated	-
Groundwater Quality and Quantity	• No potential interaction anticipated	-
Wetlands	• No potential interaction anticipated	-
Fish and Fish Habitat	• No potential interaction anticipated	-
Habitat and Flora	• No potential interaction anticipated	-
Birds	• An unplanned explosive event could potentially cause behavioral effects to birds in the area	Low
Fauna	• An unplanned explosive event could potentially cause behavioral effects to fauna in the area	Low
Species of Conservation Interest and Species at Risk	• An unplanned explosive event could potentially cause behavioral effects to	Low

Valued Component	Potential Unplanned Explosive Event and VC Interaction	Potential for Adverse Effects
	species of conservation interest and species at risk in the area	
Indigenous Peoples	• No potential interaction anticipated	-
Physical and Cultural Heritage	• An unplanned explosive event could potentially destroy undiscovered archaeological, historical, and/or paleontological artifacts	Low
Human Health and Socio-economic Considerations	• An unplanned explosive event could potentially cause injury or death to mine workers	High

Dust suspended from an unplanned explosive event would be temporary and localized to the area directly around the explosion. In addition, a release of ammonium nitrate or fuel oil to the environment is considered unlikely as the majority of these substances will be consumed should an explosion occur. Effects to birds, fauna, and SOCI/SAR will likely be minimal due to the Beaver Dam mine site being devoid of habitat once blasting commences. Effects to physical and cultural heritage will likely be minimal as well; it is anticipated that anywhere an unplanned explosive event as the potential to occur, the ground will already be disturbed by site preparation and construction activities. As a result, potentially adverse effects to the atmospheric environment, birds, fauna, SOCI/SAR, and physical and cultural heritage are considered low.

Explosives that are improperly handled pose a health and safety risk to workers during the site preparation and construction, and operation and maintenance phases of the Project, as well as a financial liability risk related to infrastructure and mobile equipment damage or loss.

The maximum effect of an unplanned explosive event as it relates to worker health and safety would be a death caused by direct interaction or from falling objects or collapsing structures damaged from the explosion. The maximum effect of an unplanned explosive event as it relates to financial lability would be a total loss of one or more pieces of infrastructure or mobile equipment.

Explosives will be supplied and managed by an off-site licensed contractor. There will be no requirement for an on-site magazine.

Mitigation and Emergency Response

Blasting will be undertaken by a qualified contractor and explosives will be stored off-site. As the magazine will be off-site there is no requirement for an on-site magazine or associated permitting through Natural Resources Canada for this Project.

6.15.4.3 Mobile Equipment Accident

All phases of the Project will have the potential for vehicular accidents to occur. A worst-case scenario would be a severe accident causing injury or death.

The majority of mobile equipment traffic will be limited to the Beaver Dam mine site where guided traffic patterns, speed limits, right-of-way signage, and training will minimize the risk of vehicular accidents. The remaining mobile equipment will include haul trucks, which will travel from the Beaver Dam surface mine to the Touquoy processing and tailings management facility. The number of return truck trips per day will be an annual average of approximately 185 for 12 or 16 hours per day, 350 days per year for the anticipated duration of the mine Project (3.3 years). During construction and pre-production (8 months), the number of trips will be less and required for moving material from Touquoy to Beaver Dam and construction and upgrade of the haul roads.

The haul road will be dual lane and designed to facilitate the safe passage of two-way truck traffic at 70 km/h. Speed limit and Right-of-way signage will be installed and all haul truck operators will receive operator training to minimize the risk of haul truck collisions. All intersections will be designed to NSTIR Standards.

Threshold for Determination of Significance

The criteria that would determine a significant effect should a mobile equipment accident occur is based primarily on worker health and safety and secondarily on property damage and environmental protection.

Should a mobile equipment accident result in injury or death to a worker or a loss of infrastructure or mobile equipment the event will be considered significant.

Should a mobile equipment accident result in the loss of any quantity of fuel, oil, lubricant, or other Project related raw materials to the environment such that a measureable contamination of soil, surface water, or groundwater results, the event will be considered significant.

Contamination is defined as the following:

- Soil
  - concentrations of any contaminant exceed the guidelines provided in the Nova Scotia Contaminated Sites Regulations – Tier 1 Environmental Quality Standards for Soil at a Non-potable Site, Section 1, Table 1B;
- Surface Water
  - concentrations of any contaminant exceed the guidelines provided in the Nova Scotia Contaminated Sites Regulations – Tier 1 Environmental Quality Standards for the Protection of Freshwater Aquatic Life in Surface Water, Section 1, Table 3;
- Groundwater
  - concentrations of any contaminant exceed the guidelines provided in the Nova Scotia Contaminated Sites Regulations – Tier 1 Environmental Quality Standards for Groundwater at a Non-potable Site, Section 1, Table 4.

Potential Interactions and Effects

The potential interactions between a mobile equipment accident and VCs are outlined in Tables 5.7-1 to 5.7-3. Additional detail by VC is outlined in Table 6.15-8. Only those interactions with a high potential to cause adverse effects should they occur are discussed in detail further.

Table 6.15-8 Mobile Equipment Accident Interactions with VCs

Valued Component	Potential Mobile Equipment Accident and VC Interaction	Potential for Adverse Effects
Atmospheric Environment	• A mobile equipment accident could potentially cause a fuel oil spill or small fire and release particulate matter, carbon monoxide, sulphur dioxide, nitrous oxides, and volatile organic compounds to the atmosphere	Low
Geology, Soil, and Sediment Quality	• A mobile equipment accident could potentially cause a release of fuel oil to soil if released to the terrestrial environment • A mobile equipment accident could potentially cause a release of fuel oil to sediment if released to the aquatic environment along the haul road.	Low
Surface Water Quality and Quantity	• A mobile equipment accident could potentially cause a release of fuel oil to watercourses along the haul road	High
Groundwater Quality and Quantity	• No potential interaction anticipated	-
Wetlands	• A mobile equipment accident could potentially cause a release of fuel oil to wetlands along the haul road	High
Fish and Fish Habitat	• A mobile equipment accident could potentially cause a release of fuel oil to fish habitat along the haul road	High
Habitat and Flora	• No potential interaction anticipated	-
Birds	• A mobile equipment accident could potentially cause bird mortality through direct strikes	Low
Fauna	• A mobile equipment accident could potentially cause fauna mortality through direct strikes	Low
Species of Conservation Interest and Species at Risk	• A mobile equipment accident could potentially cause a release of fuel oil to watercourses along the haul road • A mobile equipment accident could potentially cause aquatic based species of conservation interest and species at risk mortality through direct strikes	High / Low
Indigenous Peoples	• No potential interaction anticipated	-
Physical and Cultural Heritage	• No potential interaction anticipated	-
Human Health and Socio-economic Considerations	• A mobile equipment accident could potentially cause injury or death to mine workers	High

The emissions produced from a mobile equipment accident would be temporary and localized to the area directly around the accident. In addition, a release of fuel oil, lubricants or other Project related raw materials would be minor in volume and likely contained and cleaned up prior to significantly effecting soil or sediment quality. Effects to birds, fauna, and SOCI/SAR would be limited to death by direct strike, which would be limited to individuals rather than species populations. As a result, potentially adverse effects to the atmospheric environment, geology, soil, and sediment quality, birds, fauna, and SOCI/SAR are considered low.

Mobile equipment accidents pose an environmental risk to the following VCs:

- surface water quality and quantity;
- wetlands;
- fish and fish habitat; and
- SOCI/SAR.

The greatest potential for a mobile equipment accident to occur and cause adverse environmental effects is during the site preparation and construction, and operation and maintenance phases when the largest amount of mobile equipment is in use. The primary risk for the VCs listed above is associated with the release of fuel oil to the environment.

The magnitude of a release from mobile equipment is dependent on the severity and type of accident that occurs. A large spill can occur if an accident results in the complete destruction of a storage tank, or a small spill can occur if an accident results in a fuel line leak.

The location of the mobile equipment accident will also determine the magnitude of effects. An accident occurring within the Beaver Dam mine site boundaries is unlikely to cause significant environmental effects as the area will be largely devoid of ecological receptors and the presence of hundreds of workers will likely lead to quick and efficient containment and cleanup efforts. The primary receiver for spills as a result of accidents in this area is the soil portion of the geology, soil, and sediment quality VC. Spills are unlikely to reach surface water, sediment, groundwater, wetlands, and fish habitat due to anticipated spill response times, as well as containment and cleanup efforts. A spill occurring due to an accident along the haul road may have more significant environmental effects if the accident occurs in close proximity to a watercourse or wetland. Should this occur, the effects to surface water quality, wetland health, fish and fish habitat, and SOCI/SAR may be more pronounced.

A mobile equipment accident may pose a health and safety risk to workers during all phases of the Project, as well as a financial liability risk related to mobile equipment damage or loss. The risk of a mobile equipment accident may decrease once the operations and maintenance phase ceases, as decommissioning and reclamation will likely require fewer pieces of mobile equipment.

The maximum effect of a mobile equipment accident as it relates to worker health and safety would be a death caused by a collision of two pieces of mobile equipment, a single equipment crash, or a direct strike from mobile equipment. The maximum effect of a mobile equipment accident as it relates to financial lability would be a total loss of one or more pieces of mobile equipment.

Mitigation and Emergency Response

The majority of mobile equipment traffic will be limited to the Beaver Dam mine site where guided traffic patterns, speed limits, right-of-way signage, and training will minimize the risk of vehicular accidents. The remaining mobile equipment will include haul trucks, which will travel from the Beaver Dam surface mine to the Touquoy processing and tailings management facility. The haul road will be dual lane and designed to facilitate the safe passage of two-way truck traffic at 70 km/h. Speed limits will be enforced on the mine site and haul road.

Speed limit and right-of-way signage will be installed and all haul truck operators will receive operator training to minimize the risk of haul truck collisions. All intersections will be designed to NSTIR Standards. Communications will be maintained between vehicles using radios so that adverse conditions or collisions may be reported immediately. Operators will undergo training which will include proper procedures for daily travel to minimize the risk of vehicular accidents, as well as procedures related to emergency response should there be a vehicular accident.

Good maintenance practices for equipment and vehicle maintenance will be undertaken, including regular maintenance as specified by suppliers.

An emergency response plan will be developed for the Project and will include procedures to be followed in the event of a mobile equipment accident. The legislation is well established and understood by Atlantic Gold staff and will be conveyed to any contractors at the site so that all know of actions to take and reporting requirements.

6.15.5 Other Malfunctions

6.15.5.1 Forest and/or Site Fires

All phases of the Project will have the potential for forest and/or site fires to occur. A worst case scenario is an extreme fire that results in worker injury or death and that causes significant damage to the environment. A forest fire may occur through human or natural causes, while a site fire may occur due to an equipment failure and/or human error. Forest fires have the potential to affect the Project at the mine site and at the processing and tailings management facility; however, due to a lack of vegetation at the mine site and processing and tailings management facility, it is unlikely that a site fire could spread to and affect the surrounding forest. Forest fires along the haul road have the potential to affect haul road operations and likewise, site fires along the haul road could spread to and affect the surrounding forest.

Threshold for Determination of Significance

The criteria that would determine a significant effect should a forest and/or site fire occur is based primarily on worker health and safety and secondarily on property damage and environmental protection.

Should a forest and/or site fire result in injury or death to a worker or a loss of infrastructure or mobile equipment the event will be considered significant.

Should a forest and/or site fire result in the loss of any quantity of fuel, oil, lubricant, or other Project related raw materials to the environment such that a measureable contamination of soil, surface water, or groundwater results, the event will be considered significant.

Contamination is defined as the following:

- Soil
  - concentrations of any contaminant exceed the guidelines provided in the Nova Scotia Contaminated Sites Regulations – Tier 1 Environmental Quality Standards for Soil at a Non-potable Site, Section 1, Table 1B;
- Surface Water
  - concentrations of any contaminant exceed the guidelines provided in the Nova Scotia Contaminated Sites Regulations – Tier 1 Environmental Quality Standards for the Protection of Freshwater Aquatic Life in Surface Water, Section 1, Table 3;
- Groundwater
  - concentrations of any contaminant exceed the guidelines provided in the Nova Scotia Contaminated Sites Regulations – Tier 1 Environmental Quality Standards for Groundwater at a Non-potable Site, Section 1, Table 4.

Potential Interactions and Effects

The potential interactions between a forest and/or site fire and VCs are outlined in Table 5.7-1 to 5.7-3. Additional detail by VC is outlined in Table 6.15-9. Only those interactions with a high potential to cause adverse effects should they occur are discussed further.

Table 6.15-9 Forest and/or Site Fire Interactions with VCs

Valued Component	Potential Forest and/or Site Fire and VC Interaction	Potential for Adverse Effects
Atmospheric Environment	• A forest and/or site fire could potentially release particulate matter, carbon monoxide, Sulphur dioxide, nitrous oxides, and volatile organic compounds to the atmosphere.	Low
Geology, Soil, and Sediment Quality	• No potential interaction anticipated	-
Surface Water Quality and Quantity	• A forest and/or site fire could potentially cause surface water runoff to erode and entrain suspended solids for deposition into water courses • A forest and/or site fire could potentially reduce surface water quantity through extraction to extinguish the fire.	Low
Groundwater Quality and Quantity	• No potential interaction anticipated	-
Wetlands	• A forest and/or site fire could potentially cause wetland destruction through burning of vegetation	Low

Valued Component	Potential Forest and/or Site Fire and VC Interaction	Potential for Adverse Effects
Fish and Fish Habitat	• A forest and/or site fire could potentially cause surface water quality and quantity issues that may indirectly effect fish and fish habitat	Low
Habitat and Flora	• A forest and/or site fire could potentially cause destruction of habitat and flora	High
Birds	• A forest and/or site fire could potentially cause destruction of bird habitat and/or direct mortality	High
Fauna	• A forest and/or site fire could potentially cause destruction of fauna habitat and/or direct mortality	High
Species of Conservation Interest and Species at Risk	• A forest and/or site fire could potentially cause destruction of species of conservation interest and species at risk	High
Indigenous Peoples	• A forest and/or site fire could potentially cause effects to the current use or land and resources for traditional purposes by Indigenous Peoples	Low
Physical and Cultural Heritage	• No potential interaction anticipated	-
Human Health and Socio-economic Considerations	• A forest and/or site fire could potentially cause injury or death to mine workers	High

The topographic profile of the region allows for precipitation to be retained in soil and numerous watercourses and wetlands to form. As a result, large forest and/or site fires are unlikely to occur. In the unlikely event a forest and/or site fire occurs, the following adverse effects to VCs are considered low:

- emissions produced from a forest and/or site fire would be temporary; however, may adversely affect ambient air quality in the area;
- surface water run-off created from extinguishing the fire may transport sediment and potential contaminants towards watercourses along the haul road; thereby affecting surface water quality;
- surface water quantity in watercourses near the Beaver Dam mine site may be slightly affected through extraction and use of surface water for extinguishing the fire; however, these watercourses will only be utilized to aid in extinguishing small localized fires;
- effects to wetlands and fish and fish habitat are expected to be minimal due to the presence of water and saturated soils and flora; and
- unless a forest and/site fire extends to the Beaver Lake IR 17, it is unlikely that Indigenous Peoples will be adversely affected by forest and/or site fires.

As a result, potentially adverse effects to the atmospheric environment, surface water quality and quantity, wetlands, fish and fish habitat, and Indigenous Peoples are considered low.

The greatest potential for a forest and/or site fire to occur as a result of the Project is during the site preparation and construction, and operation and maintenance phases when the greatest amount of physical activity is occurring at the at the Beaver Dam mine site and along the haul road. The primary risk for the environment is associated with physical habitat destruction and death of terrestrial species.

A forest and/or site fire caused by the Project has the potential to modify terrestrial habitat and cause direct mortality to wildlife populations, especially during the breeding season when the mobility of immature individuals is limited. The destruction of habitat may result in the loss of breeding, nesting, rearing, and/or other habitat for birds, fauna, and SOCI/SAR. Habitat fragmentation created by a fire may cause potential adverse effects for species that migrate throughout a landscape based on resources that a seasonally available.

Although a forest and/or site fire caused by the Project is likely to be extinguished before it creates a significant effect to the local area, it is unlikely that terrestrial habitat loss or direct individual mortality would create population viability issues if an uncontrollable fire was allowed to burn. It is likely that mobile terrestrial species will move to adjacent areas and any habitat loss would lead to regrowth within a few generations. In addition, habitat types in the area of the Project are not unique and would be easily supplanted with minor migration efforts by terrestrial species.

A forest and/or site fire created by the Project would likely result from a structural failure or accident identified in Sections 6.15.3 and 6.15.4 of this EIS. Should the mitigation measures for these structural failures or accidents be implemented, it is extremely unlikely that a forest and/or site fire created by the Project would occur.

Mitigation and Emergency Response

Adequate fire protection for the Beaver Dam mine site will be provided, and will likely consist of a truck equipped with a water tank and pumps. All large equipment on the mine site will have fire suppression equipment. Supplementary hand held fire extinguishers, each suitable for its specific area, will be mounted in all buildings and vehicles. It is intended that firefighting activities will be handled by the local fire authority in Upper Musquodoboit and Sheet Harbour.

Fire detection systems will be installed in all buildings and in key areas of the mine site. Fire response training and fire extinguisher training will be provided to all staff. An emergency response plan will be developed for the site, which will include fire response.

The site will be staffed to varying levels 24 hours a day with personnel in all areas of the site. Fires, if they occur, would be quickly detected and emergency procedures able to be acted on. The availability of water, equipment and nearby personnel from volunteer fire departments and NSDNR staff with expertise in forest fire control are all benefits to the Project and greatly reduce the possibility of fires that would not be able to be quickly controlled, and damage limited.

6.15.6 Risk Assessment

Each potential accident and malfunction identified in the previous sections was assessed considering the likelihood of occurrence and the level magnitude should these accidents and malfunctions occur.

The likelihood of occurrence is given a score of 1 to 5 with an associated rating as defined below:

1. **Negligible**
    - accident or malfunction not likely to occur with a less than 1 in 10,000 probability of occurrence per year;
2. **Low**
    - accident or malfunction unlikely to occur with a less than 1 in 1,000 probability of occurrence per year;
3. **Moderate**
    - accident or malfunction has potential to occur with a less than 1 in 100 probability of occurrence per year;
4. **High**
    - accident or malfunction may occur with a less than 1 in 10 probability of occurrence per year; and
5. **Extreme**
    - Accident or malfunction is likely to occur with a greater than 1 in 10 probability of occurrence per year.

The level of magnitude should these accidents and malfunctions occur is also given a score of 1-5 with an associated rating as defined below:

1. **Negligible**
    - preventative requirements are minimal,
    - no long term effects are expected, and
    - readily remediated with funds in the $0 to $10,000 range;
2. **Low**
    - preventative requirements are minimal,
    - limited long term effects are expected, and
    - limited remediation required with funds in the $10,000 to $100,000 range;
3. **Moderate**
    - preventative requirements are moderate,
    - moderate long term effects are expected, and
    - moderate remediation required with funds in the $100,000 to $1,000,000 range;
4. **High**
    - preventative requirements are high,
    - significant long term effects are expected, and
    - significant remediation required with funds in the $1,000,000 to $10,000,000 range; and
5. **Extreme**
    - Preventative requirements are very high,
    - permanent effects are expected, and

- highly significant remediation required with funds in the $10,000,000 plus range.

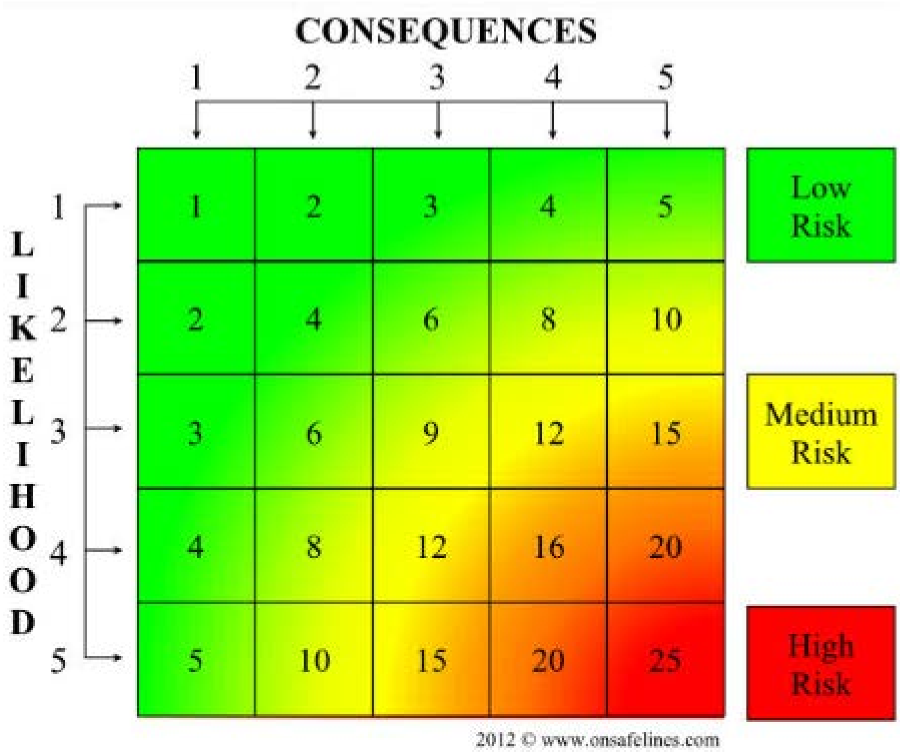


Figure 6.15-1 Risk Ranking Matrix

Each potential accident and malfunction is assigned a likelihood rating and level of magnitude rating based on the definitions provided above, activities associated with the Project, and the professional knowledge and judgement of the EA Study Team. The two ratings are multiplied and plotted on the Risk Rating Matrix provided on Figure 6.15-1 to obtain a risk rating for each accident and malfunction. Risk ratings can range from 1 to 25 – an accident and malfunction having a rating of 1 presents a negligible risk, while an accident and malfunction having a rating of 25 presents an extreme risk. As shown in the Risk Rating Matrix, the level of risk associated with an accident and malfunction is proportionally related to its likelihood of occurrence and the magnitude of effects it causes. Table 6.15-10 provides the breakdown of ratings used to obtain the risk rating for each accident and malfunction, as well as summarizes the key VCs that would likely be affected.

Table 6.15-10 Characterization Criteria for Risk Rating Matrix

Accident/ Malfunction	Worst-case Scenario (Potential Consequences)	Key VC(s) Potentially Affected	Likelihood Rating	Magnitude Rating	Risk Rating 1 = Minimum 25 = Maximum
Surface Mine Slope Failure	Ground surface slump of the surrounding area affecting the site's infrastructure, haul roads	Human Health and Socio-economic Considerations	1	4	4

Table 6.15-10 Characterization Criteria for Risk Rating Matrix

Accident/ Malfunction	Worst-case Scenario (Potential Consequences)	Key VC(s) Potentially Affected	Likelihood Rating	Magnitude Rating	Risk Rating 1 = Minimum 25 = Maximum
	and on-site access roads and worker safety.				
Stockpile Slope Failure	Potential for mine rock and low-grade ore to enter nearby watercourses, damage to infrastructure and to worker safety.	Human Health and Socio-economic Considerations	2	4	8
Settling Pond Failure	Uncontrolled discharge of sediment laden water into the surrounding environment.	Surface Water Quality and Quantity Wetlands Fish and Fish Habitat Species of Conservation Interest/Species at Risk	2	3	6
Infrastructure Failure	Failure of multiple operational components as a result of a natural cause impacting worker health and safety and surrounding environment.	Human Health and Socio-economic Considerations	1	3	3
Fuel and/or Other Spills	Transportation collision causing the entire amount of fuel or hazardous material being transported to be spilled into a water body	Geology, Soil, and Sediment Quality Surface Water Quality and Quantity Groundwater Quality and Quantity Wetlands Fish and Fish Habitat Species of Conservation Interest/Species at Risk	2	4	8
Unplanned Explosive Event	Bodily harm and infrastructure damage as a result of improperly handling explosives.	Human Health and Socio-economic Considerations	1	4	4
Mobile Equipment Accident	Severe accident causing injury or death, property damage and environmental impacts.	Surface Water Quality and Quantity Wetlands Fish and Fish Habitat Species of Conservation Interest/Species at Risk	2	4	8

Table 6.15-10 Characterization Criteria for Risk Rating Matrix

Accident/ Malfunction	Worst-case Scenario (Potential Consequences)	Key VC(s) Potentially Affected	Likelihood Rating	Magnitude Rating	Risk Rating 1 = Minimum 25 = Maximum
		Human Health and Socio-economic Considerations			
Forest and/or Site Fire	An extreme fire that results in worker injury or death and causes significant damage to the environment.	Habitat and Flora Birds Fauna Species of Conservation Interest/Species at Risk Human Health and Socio-economic Considerations	1	5	5

6.15.7 Discussion

Potential accidents and malfunctions assigned a risk rating of 1-5 are considered low risk, those assigned a risk rating of 6-15 are considered moderate risk, and those assigned a risk rating of 16-25 are considered high risk. If an accident or malfunction is assigned a risk rating of 16 or higher, it is considered significant and requires further consideration during the Project's detailed design phase. The results of this qualitative analysis indicate that a mobile equipment accident and fuel and/or other spill are considered the most risky; however, all identified accidents and malfunctions have a low or moderate risk rating and are therefore considered not significant.

7. Effects of the Environment on the Project

7.1 Environmental Considerations

The effects of the environment on the Project must also be considered as part of the EIS. This includes how local conditions, natural hazards, and external events could affect the Project. Additionally, it is important to consider how the effects of these local conditions, natural hazards, and external events on the Project may in turn affect the environment, such as accidents or malfunctions occurring on the Project site.

The natural environment has the ability to potentially adversely impact the Project through events which may include the following:

- flooding;
- drought;
- extreme temperatures;

- Severe weather events, including snow, ice, rain, and wind storms;
- lightning strikes;
- landslides, erosion, or subsidence;
- fire; and
- seismic events

Mine site infrastructure will be designed to accommodate the conditions imposed by the natural environment and to accommodate the effects of external events on the Project, as much as possible.

7.1.1 Extreme Weather

7.1.1.1 Flood and Drought Conditions

Flooding or drought conditions may occur during the lifespan of the Project. These events can generally be accommodated in the Project design and construction. The historical mean annual total precipitation for the Middle Musquodoboit climate station is 1350 mm. Approximately 1,188 mm fell as rain, while 172 cm fell as snow. Although extreme precipitation events may occur at any time during the year, rainfall in the Project area is generally highest during fall. The extreme one day precipitation events recorded at the Middle Musquodoboit station is 173 mm of rainfall on August 15, 1971 and 70 cm of snowfall on February 8, 1981.

The effects of a drought or flood on the Project may include increased dust and decreased availability of water for site operations or an excess of water on the mine site and haul road. Potable groundwater will be brought to the site and therefore a reduction in the availability of potable groundwater is not anticipated to be an adverse effect. Minimal volumes of water from the settling ponds are anticipated to be re-used on Site for dust suppression purposes, as required. The majority of water collected in the settling pond will be released to Cameron Flowage. A reduction in water being collected by the settling ponds will result in less water being released to Cameron Flowage and is not anticipated to affect site operations. In the event of a 1 in 100 year precipitation event that creates volumes in excess of the capacity available in ponds and ditching, or infrastructure failure, a spillway into the water diversion structure will be used for overflow. In the case of a storm event or infrastructure failure, settling ponds will be monitored regularly. The haul roads could also become flooded and the transportation of ore may temporarily be suspended.

7.1.1.2 Extreme Temperatures, Storms, and Wind

Air temperatures vary seasonally. Average temperatures for the area are 6.2 °C, with an average range from -6 °C to 18.1 °C. Temperature extremes can range from -34 °C to 35 °C. There is an average of 312 days per year with an average temperature above 0 °C. The Project will be designed to accommodate these temperature ranges.

Extreme temperatures and storms (ice, snow) could cause damage to site infrastructure or could directly impact site workers. An Occupational Health and Safety Plan will be implemented to ensure worker safety during extreme temperature events and storm events.

Wind direction is generally westerly to northerly in November through April and southerly in May through October. Wind speeds average approximately 16.5 km/h, with an average range of 13.3 km/h in August to 18.5 km/h in March. Maximum hourly speeds can range from 56 km/h in August to 89 km/h in February, with maximum gusts of up to 132 km/h recorded. The Project will be designed to accommodate these wind speed ranges.

7.1.1.3 Lightning Strikes

Thunderstorms are not overly common in the Project area. In Nova Scotia, cloud to ground lightning typically occurs between the months of March to November (ECCC 2016e). The average number of days with lightning (years 1999-2013) was 12.1 days in Halifax, and 12.6 days in Truro.

In the event of a lightning strike, damage to site infrastructure or injury to site workers could occur. A power surge or outage could also occur. Designing infrastructure with proper grounding circuits, as per standard practice, would help to prevent damage or injury.

7.1.2 Climate Change

The Project is relatively short in duration (approximately 8 years including reclamation and not including ongoing monitoring) and therefore the interaction of the Project with weather events caused by climate change over time will be difficult to assess over the life of the Project. However, the Project may be affected by climate change-induced events, such as increased annual precipitation and more frequent extreme weather events.

Climate change is anticipated to cause an increase in frequency and intensity of extreme weather events, warmer average temperatures, higher sea levels, and more extreme rainfall and flooding events (DeRomilly and deRomilly Limited et al. 2005). More frequent and intense extreme weather events could cause an increased risk of flooding and snow and ice storms. Increased flood events would also increase the risk of erosion. Existing infrastructure in Canada was not intended to withstand the more extreme and frequent storms that may be experienced in coming years; however, new construction can take this into consideration. The Project will be designed to withstand more extreme precipitation events, including the effects of these events such as flooding and erosion.

Although air temperatures are expected to warm over time, extreme warming events are not anticipated to increase significantly (NS 2005). Additionally, due to the limited duration of the Project, warming air temperatures are not anticipated to affect the Project. The potential for forest fires is also considered to be low as the mine site will be mostly cleared of trees and the limited duration of the Project indicates that warming air temperatures will not affect the Project.

7.1.3 Slope Stability

All phases of the Project have the potential for slope failures within the footprint of the surface mine, and the topsoil, till, and waste rock stockpiles. All of these slopes will be designed at an angle determined by geotechnical analysis and acceptable safety factors. However, in the event of an extreme weather event or seismic event, slope failure may be possible.

Features constructed from site materials such as waste rock stockpiles and overburden stockpiles will use the collected data for final design to produce features with appropriate safety factors to reduce the possibility of landslides, slope erosion and subsidence. With many stockpiles it is common to have subsidence in the short term creating a landscape that is varied in topography. This approach aligns with NSDNR objectives for reclamation to have surfaces that are not uniform but offer safe long term landscapes with a variety of features.

7.1.4 Seismic Events

Although seismic activity is unpredictable, all of Nova Scotia is located in a next-to-lowest hazard zone, with moderate to high hazard zones located offshore in the southern Bay of Fundy and along the Laurentian Slope (NRCAN 2015).

The Northern Appalachians Seismic Zone is located in southwest Nova Scotia. The Beaver Dam Mine Project is located east of this zone. The nearest earthquake to Marinette, Nova Scotia was recorded with a magnitude of 2.7 in 1999 and was located northeast approximately 20 km north of the Project area. If an earthquake occurs, seismic activity may affect the Beaver Dam Mine Project through primary impacts such as slope and mine wall failures, and infrastructure damage facilitated by ground vibrations and secondary impacts such as fires facilitated by damaged infrastructure. Tsunami's, should they be created by offshore earthquakes, are unlikely to impact the Project. The Project is approximately 30 km from the coast and at an elevation of 140 masl. Given that Nova Scotia is located in a low hazard zone and the limited extent and duration of the Project, the potential risk of seismic activity affecting the Project is very low and not considered significant.

Site infrastructure will be built to the National Building Code of Canada, to aid in mitigating damage to infrastructure or injury to site workers in the event of an earthquake in the Project area.

7.2 Mitigations

The Beaver Dam mine site will be designed to use commonly utilized infrastructure which will be designed to consider extreme weather events. Climate change is not anticipated to have a significant effect on the Project, based on the relatively short duration of the Project.

The following mitigation measures will be applied to reduce the potential effects of the environment on the Project:

- Project design will consider potential flood or drought conditions to minimize the impacts of these events on mine infrastructure.
- Project design will accommodate temperature extremes, storms, and wind speed ranges identified for the Project area.
- Project design will follow industry standards, including the National Building Code of Canada, to prevent damage to equipment or injury to site workers.
- Topsoil, till, and waste rock stockpiles will be designed with slopes designed at an angle determined by geotechnical analysis and acceptable safety factors. Stockpiles will be constructed using collected geological data for final design and reduce the possibility of landslides, slope erosion, and subsidence.

- An Emergency Response Plan will be implemented for the mine site and will consider measures that may be required during an extreme weather event to secure site infrastructure, mobile equipment, stockpiles, fuel storage, and electrical equipment
- An Occupational Health and Safety Plan will be implemented for the mine site and will consider measures that may be required during an extreme weather or temperature event, flood or drought, or storm event.

Table 7.2-1 Mitigation and Monitoring Program for Effects of the Environment on the Project

Project Activity	Mitigation Measures	Mitigation and Monitoring Program
Site Preparation and Construction	Minimize effects of extreme weather on the Project during the construction phase	• Project design to consider extreme weather events, temperature extremes, wind speed ranges, flood or drought conditions, lightning strikes. • Project design will follow industry standards, including the National Building Code of Canada. • An Emergency Response Plan will be implemented during the construction phase. • An Occupational Health and Safety Plan will be implemented to protect worker health and safety
	Minimize the potential for slope failure	• Stockpile design will consider collected geological data and will be designed with slopes at the angle determined by geotechnical analysis and acceptable safety factors. • An Emergency Action Plan will be implemented during the construction phase
Operation and Maintenance	Minimize effects of extreme weather on the Project during the operations phase	• An Emergency Action Plan will be implemented during the operations phase. • An Occupational Health and Safety Plan will be implemented to protect worker health and safety
	Minimize the potential for slope failure	• Stockpile design will consider collected geological data and will be designed with slopes at the angle determined by geotechnical analysis and acceptable safety factors • An Emergency Action Plan will be implemented during the operation phase
Decommissioning and Reclamation	Minimize the potential for slope failure	• Stockpile design will consider collected geological data and will be designed with slopes at the angle determined by geotechnical analysis and acceptable safety factors.

7.3 Residual Effects

There are no significant adverse environmental effects anticipated due to the environment, once mitigation measures are applied. Potential effects of the environment on the Project will be reduced as much as possible through proper design and planning and mitigation measures outlined above. Extreme weather events cannot be predicted, but through proper design and planning the majority of the effects of these events on the Project may be minimized.

8. Cumulative Effects Assessment

8.1 Regulatory Framework

The *Canadian Environmental Assessment Act, 2012* (CEAA 2012) requires that an EA of a designated project take into account any cumulative environmental effects that are likely to result from the designated project in combination with the environmental effects of other physical activities that have been or will be carried out[2].

A cumulative effects assessment was therefore carried out in order to meet the general requirements of the CEAA 2012, as well as the specific requirements laid out in the *Guidelines for the Preparation of an Environmental Impact Statement pursuant to the Canadian Environmental Assessment Act, 2012* and *Nova Scotia Registration Document pursuant to the Nova Scotia Environment Act – Beaver Dam Mine – Atlantic Gold Corporation*.

8.2 Cumulative Assessment Methodology

8.2.1 General Approach

The general approach of the cumulative impact assessment is based on the Agency's Operational Policy Statement entitled Addressing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012 and the guide entitled Cumulative Effects Assessment Practitioners' Guide, 1999 (Hegmann *et al.,* 1999).

The main steps involved in this approach are as follows:

- The initial steps cover the scoping of the cumulative effects assessment and include:
    - Identification of the valued components (VCs) that will constitute the focus of the cumulative effects assessment.
    - Determining the spatial and temporal boundaries for each VC.
    - Identification, selection and description of projects in the area.
- The following steps constitute the analysis of the cumulative effects assessment and are presented separately for each VC selected at the scoping stage:

[2] *Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012*. https://www.canada.ca/en/environmental-assessment-agency/news/policy-guidance/assessing-cumulative-environmental-effects-under-canadian-environmental-assessment-act-2012.html

- o Description of the baseline conditions.
- o Description of the residual effects of the proposed Project.
- o Description of the effects of other projects in the area.
- o Description of the cumulative effects.
- o Proposed mitigation and monitoring.
- o Residual Cumulative Effects and Significance Assessment.
- o Follow-up.

The methodology used for each of these steps is presented in the following sections.

8.2.2 Identification of the Valued Components that will constitute the Focus of the Cumulative Effects Assessment

In order to identify the VCs that are likely to be affected by cumulative effects resulting from the proposed Project and other projects in the area, each of the VCs taken into account in the environment effects assessment of the proposed Project (Section 6) is analyzed. In order to be included in the cumulative effects assessment, adverse residual effects must have been identified for the VC. The selected VCs include those identified in the Agency's *Guidelines for the Preparation of an Environmental Impact Statement pursuant to the Canadian Environmental Assessment Act, 2012* and *Nova Scotia Registration Document pursuant to the Nova Scotia Environment Act – Beaver Dam Mine – Atlantic Gold Corporation*:

- fish and fish habitat;
- birds (including migratory birds);
- species at risk; and
- Indigenous peoples.

Key stakeholders and Aboriginal groups were consulted prior to finalizing the choice of VCs and the appropriate boundaries to assess cumulative effects.

8.2.3 Determining the Spatial and Temporal Boundaries

The spatial and temporal boundaries to be considered in the cumulative impact assessment are determined individually for each selected VC. Minimally, these boundaries are those applied in the assessment of Project effects. However, in many cases the cumulative boundaries are larger. This determination is based on the nature of the VC and of the likely cumulative effects.

The main points taken into consideration in determining spatial boundaries were:

- Whether the effects of different project to a VC could be additive if felt at separate locations;
- The expected geographical extent of the project effects on the VC;
- The determination of the appropriate geographic scale required to assess the effects on a biological population. In most cases, a broad, regional area was considered appropriate, though

the existence of physical boundaries between populations was taken into account. For example, effects to fish populations were considered cumulative with a watershed.

In the determination of temporal boundaries, the following points were taken into account:

- Duration of the expected environmental effects.
- The timing of the expected environmental effects.
- Whether or not the effects are only additive if felt simultaneously.

For example, it was considered for most physical VCs that effects could only be cumulative if the effects of two projects overlap in time and space. For example, cumulative effects on water quality that exceed those assessed for an individual project are only possible if two projects affect the same body of water.

However, for other VCs, such as wildlife or bird populations, effects from projects that do not overlap in space may have cumulative effects if their effects reach the same population. The spatial cumulative effects boundaries for such VCs may therefore be wider than those used to assess the effects of an individual project and should generally be determined in a way that is ecologically defensible.

Temporal cumulative effect boundaries take into account the timing at which a type of effect has occurred in the past or is expected to occur in the future, as well the expected duration of the effect. For example the cumulative effects of habitat loss could start with the first historical effects on the habitat in question and end with the recovery of the lost habitat.

8.2.4 Identification, Selection and Description of Projects in the Area Past, Present and Future Physical Activities

Information regarding upcoming and past projects was obtained from a review of new and existing projects listed on the NSE Environmental Assessment Division website and well as the CEA Agency's online registry. In addition, a generalized internet search was used to identify other anticipated or ongoing projects.

A search was conducted to identify all major projects within the region with a potential to have cumulative effects with the Beaver Dam Mine Project. In order to include projects that overlap the VCs with the largest relevant spatial boundaries, the search area included the region within a 35 km radius of the Beaver Dam Mine Project Area.

Based on the nature and location of the identified projects, an initial assessment of the most likely potential cumulative effects between each project and the Beaver Dam Mine Project has been undertaken.

8.2.5 Baseline Conditions

A description of the baseline conditions is given for each of the selected VCs within their designated spatial and temporal boundaries. Emphasis is put on aspects of the VC that are likely to be affected by cumulative effects between the Beaver Dam Mine Project and the other identified projects in the area.

8.2.6 Identification and Assessment of the Cumulative Effects

The first step in the assessment of the cumulative effect is to describe the residual effects of the Beaver Dam Project, based on the results of the environmental effects assessment. The environmental effects assessment methodology used for the Project is presented in Section **5.**.

This is followed by the identification of any effects of the other projects identified in the area that may act in combination with the residual effects of the Beaver Dam Project. If available, environment impact assessments for identified projects with potential cumulative effects were consulted. In addition, information contained in the baseline conditions for a VC often included a description of the effects of past and ongoing activities as these have left their mark on the current conditions.

In the case of past activates, their effects can be used to contextualize the current state of the VC as described in the baseline conditions. Taking this information into consideration, the total cumulative effects of all projects having an effect on the selected VC is then described as to their nature, scope and intensity. An assessment of the relative contribution of the Beaver Dam Project on the overall cumulative effects is given by comparing these effects with and without the inclusion of the proposed project.

As indicated in the *Guidelines for the Preparation of an Environmental Impact Statement pursuant to the Canadian Environmental Assessment Act, 2012 – And Nova Scotia Registration Document pursuant to the Nova Scotia Environment Act – Beaver Dam Mine – Atlantic Gold Corporation*, the assessment of cumulative effects on current use of lands and resources for traditional purposes by Indigenous peoples focusses on the effects on specific activities such as hunting, fishing, trapping and plant harvesting.

8.2.7 Mitigation and Monitoring

As a first step, an assessment of whether any additional mitigation measures beyond those proposed in the environmental effects assessment of the Project (Section 6) is made. If additional technically and economically feasible measures are warranted to reduce the cumulative effects, these are proposed.

Given the large spatial and temporal cumulative effects boundaries of certain VCs, the implementation of mitigation measures may exceed the scope of the proponent’s responsibility. In such cases the parties that have the authority to act are identified and any discussions that have taken place in order to implement the necessary measures over the long term are summarized.

8.2.8 Residual Cumulative Effects and Significance Assessment

The residual cumulative effects, taking into account the implementation of the mitigation measures, are described. These are then compared to the significance thresholds identified for each VC in order to determine if they are significant.

8.2.9 Follow-up

If it is considered warranted, after taking into account the confidence level of the predictions of the residual cumulative effects and the expected scale of the effects, a follow-up program is proposed to verify the accuracy of the assessment or to dispel the uncertainty concerning the effectiveness of mitigation measures for certain cumulative effects.

8.3 Identification of the Valued Components

The VCs included in the environmental effects assessment of the Project (section 6) were each assessed as to whether they are likely to be impacted by cumulative effects. The selection criteria, spatial and temporal boundaries and indicators for each VC are presented in Table 8.3-1. The VCs taken into consideration are the following:

- Physical Environment
  - Atmospheric Environment
  - Geology, Soil and Sediment Quality
  - Surface Water Quality and Quantity
  - Groundwater Quality and Quantity
- Biophysical Environment
  - Wetlands
  - Fish and Fish Habitat
  - Habitat and Flora
  - Terrestrial Fauna
  - Birds
  - Species of Conservation Interest and Species at Risk
- Socio-Economic Environment
  - Indigenous Peoples
  - Physical and Cultural Heritage
  - Human Health and Socio-Economic Conditions.

All of the VCs have been included in the Cumulative Effects Assessment with the exception of two. The VCs that were not selected include the following:

- Geology, Soil and Sediment Quality - adverse residual effects from the Project are not anticipated;
- Physical and Cultural Heritage - no other projects or activities with likely impacts to physical or cultural heritage sites were identified within the cumulative effects spatial boundaries.

Table 8.3-1 Selecton of Valued Components for the Cumulative Effects Assessment

	SPATIAL BOUNDARIES								
VALUED COMPONENT	Project Area	Assessment Area	Assessment Area	Description	TEMPORAL BOUNDARIES	RESIDUAL EFFECTS	Valued Component Selected for the Cumulative Effects Assessment	SPATIAL BOUNDARIES OF CUMULIVE EFFECTS ASSESSMENT	TEMPORAL BOUNDARIES OF CUMULIVE EFFECTS ASSESSMENT
Physical Environment									
Atmospheric Environment	X	X	X	The spatial boundary used for the assessment of effects to the atmospheric environment, including the climate and greenhouse gas emissions, is the RAA. The spatial boundary used for the assessment of effects to the atmospheric environment, including air quality, noise, and ambient light, is the LAA. As the Project has the potential to cause direct and indirect effects to the atmospheric environment, as well as cumulative effects compounded spatially and temporally from other Projects, the RAA and LAA are the most appropriate spatial boundaries, respectively.	Construction phase, operational phase, and decommissioning and reclamation phase.	The predicted residual environmental effects of project development and production on the atmospheric environment are assessed to be adverse, but not significant.	Yes	Same as for Project effects. Wider scale for climate change and GHG. Cumulative effects on air quality, noise, and ambient light are only possible within the areas directly impacted by the project.	Same as for project effects. Cumulative effects only possible for simultaneous activities.
Geology, Soil and Sediment Quality	X	X		The spatial boundary used for the assessment of effects to geology, soil, and sediment is the LAA. As the Project has the potential to cause direct and indirect effects to geology, soil, and sediment within and immediately adjacent to the project area, the LAA is the most appropriate spatial boundary.	Construction phase, operational phase, and decommissioning and reclamation phase.	Residual effects for geology, soils and sediment are not anticipated.	No	NA	NA
Surface Water Quality and Quantity	X	X		The spatial boundary used for the assessment of effects to surface water quality and quantity is the RAA. As the Project has the potential to cause direct and indirect effects to surface water quality and quantity, as well as cause cumulative effects compounded spatially and temporally from other Projects, the RAA is the most appropriate spatial boundary. The RAA in the context of surface water quality and quantity is limited to the catchment areas identified in Tables 6.3-XX and 6.3-XX, and corresponding Figures 6.3-1 and 6.3-2.	Construction phase, operational phase, and decommissioning and reclamation phase.	The predicted residual environmental effects of project development and production on surface water are assessed to be adverse, but not significant.	Yes	Same as for Project effects. Cumulative effects on water quality are only possible within the areas directly impacted by the project.	Same as for project effects. Cumulative effects only possible for simultaneous activities.
Groundwater Quality and Quantity	X	X		The spatial boundary used for the assessment of effects to groundwater quality and quantity is the RAA. As the Project has the potential to cause direct and indirect effects to groundwater quality and quantity, as well as causing cumulative effects compounded spatially and temporally from other Projects, the RAA is the most appropriate spatial boundary. The RAA in the context of groundwater quality and quantity is limited to groundwater and surface watersheds in and immediately adjacent to the PA.	Construction phase, operational phase, and decommissioning and reclamation phase.	The predicted residual environmental effects of project development and production on groundwater are assessed to be adverse, but not significant.	Yes	Same as for Project effects. Cumulative effects on water quality are only possible within the areas directly impacted by the project.	Same as for project effects. Cumulative effects only possible for simultaneous activities.

Table 8.3-1 Selecton of Valued Components for the Cumulative Effects Assessment

VALUED COMPONENT	SPATIAL BOUNDARIES				TEMPORAL BOUNDARIES	RESIDUAL EFFECTS	Valued Component Selected for the Cumulative Effects Assessment	SPATIAL BOUNDARIES OF CUMULIVE EFFECTS ASSESSMENT	TEMPORAL BOUNDARIES OF CUMULIVE EFFECTS ASSESSMENT
	Project Area	Assessment Area	Assessment Area	Description					
Biophysical Environment									
Wetlands	X	X		The spatial boundaries used for the assessment of effects to wetlands are the project areas (PA) for the mine footprint and the haul road, and the LAA consisting of surface water systems immediately adjacent to and receiving drainage from the PA.	Construction phase, operational phase, and decommissioning and reclamation phase.	The predicted residual environmental effects of project development and production on wetlands are assessed to be adverse, but not significant.	Yes	Same as for project effects, but with the addition of the PA and LAA of the Touquoy processing site.	Effects on habitats can be long lasting. Boundary set from beginning of mining and forestry in the region, with effects potentially continuing into the future.
Fish and Fish habitat	X	X		The spatial boundaries used for the assessment of effects to fish and fish habitat are the project areas for the mine footprint and the haul road, and the LAA consisting of surface water systems immediately adjacent to and receiving drainage from the PAs, within each affected tertiary watershed (seven along haul road PA and three within the mine footprint PA).	Construction phase, operational phase, and decommissioning and reclamation phase	The predicted residual environmental effects of project development and production on fish and fish habitat are assessed to be adverse, but not significant.	Yes	Effects can be cumulative for projects affecting the same population of fish. We therefore considered effects at the level of the watershed. This is the same as for project effects but with the addition of the PA and LAA of the Touquoy processing site.	Long term effects on populations are possible. Temporal boundaries set to a decade before and after the project phases.
Habitat and Flora	X	X		The spatial boundaries used for the assessment of effects to flora are the mine footprint and the haul road PA. The LAA consists of any habitat contiguous and consistent with habitat available within the PA.	Construction phase, operational phase, and decommissioning and reclamation phase.	The predicted residual environmental effects of project development and production on habitat and flora are assessed to be adverse, but not significant.	Yes	Same as for project effects, but with the addition of the PA and LAA of the Touquoy processing site.	Effects on habitats can be long lasting. Boundary set from beginning of mining and forestry in the region, with effects potentially continuing into the future.
Terrestrial Fauna	X	X		The spatial boundaries used for the assessment of effects to terrestrial fauna are the PA for the mine footprint and the haul road. The LAA consists of any habitat contiguous and consistent with habitat available within the PA.	Construction phase, operational phase, and decommissioning and reclamation phase.	The predicted residual environmental effects of project development and production on terrestrial fauna are assessed to be adverse, but not significant.	Yes	Effects can be cumulative if they affect the same population at the regional level. The RAA is therefore chosen as the appropriate boundary.	Effects on habitats can be long lasting. Boundary set from beginning of mining and forestry in the region, with effects potentially continuing into the future.
Birds	X	X		The spatial boundaries used for the assessment of effects to birds are the mine footprint and the haul road PA, and the LAA which consists of any habitat contiguous and consistent with habitat available within the PA.	Construction phase, operational phase, and decommissioning and reclamation phase.	The predicted residual environmental effects of project development and production on birds and bird habitat are assessed to be adverse, but not significant.	Yes	Effects can be cumulative if they affect the same population at the regional level. The RAA is therefore chosen as the appropriate boundary.	Effects on habitats can be long lasting. Boundary set from beginning of mining and forestry in the region, with effects potentially continuing into the future.

Table 8.3-1 Selecton of Valued Components for the Cumulative Effects Assessment

VALUED COMPONENT	SPATIAL BOUNDARIES: Project Area	SPATIAL BOUNDARIES: Assessment Area	SPATIAL BOUNDARIES: Assessment Area	SPATIAL BOUNDARIES: Description	TEMPORAL BOUNDARIES	RESIDUAL EFFECTS	Valued Component Selected for the Cumulative Effects Assessment	SPATIAL BOUNDARIES OF CUMULIVE EFFECTS ASSESSMENT	TEMPORAL BOUNDARIES OF CUMULIVE EFFECTS ASSESSMENT
Species of Conservation Interest and Species at Risk	X	X		The spatial boundaries used for the assessment of effects for all Species at Risk and Species of Conservation Interest include the mine footprint and the haul road PA. The LAA consists of any habitat contiguous and consistent with habitat available within the PA upon which SAR or SOCI rely (i.e. critical habitat, if critical habitat is identified). Further guidance on inclusion of LAA within the effects assessment process is specific to each taxa and is provided herein: • Fish: LAA is the watercourse, and any contiguous upstream watercourses, waterbodies and wetlands connected by obvious surface flow; • Vascular Flora and Lichens: LAA is the habitat which is contiguous and consistent with the habitat in which the species is located, up to and including the entire forest stand; • Terrestrial Fauna: LAA is habitat consistent with and contiguous with habitat available within the PA, plus a 1km buffer (based on the recommended buffer for determining risks to bat SAR, identified above); and, • Birds: LAA is habitat consistent with and contiguous within habitat within the PA, plus a 1km buffer. In this case, the 1km buffer is based on breeding territory and home range for most priority bird species identified within the PA.	Construction phase, operational phase, and decommissioning and reclamation phase.	The predicted residual environmental effects of project development and production on SOCI and SAR are assessed to be adverse, but not significant.	Yes	Cumulative impacts are assessed at the level of the population at risk. This can vary between species but will minimally be at the level of the RAA.	Effects on habitats can be long lasting. Boundary set from beginning of mining and forestry in the region, with effects potentially continuing into the future.

Table 8.3-1 Selecton of Valued Components for the Cumulative Effects Assessment

VALUED COMPONENT	SPATIAL BOUNDARIES				TEMPORAL BOUNDARIES	RESIDUAL EFFECTS	Valued Component Selected for the Cumulative Effects Assessment	SPATIAL BOUNDARIES OF CUMULIVE EFFECTS ASSESSMENT	TEMPORAL BOUNDARIES OF CUMULIVE EFFECTS ASSESSMENT
	Project Area	Assessment Area	Assessment Area	Description					
Socio-Economic Environment									
Indigenous Peoples	X	X	X	The spatial boundary used for the assessment of effects to Indigenous People is the RAA. The Project has the potential to cause direct and indirect effects to health and socio-economic conditions, physical and cultural heritage, and current use of lands and resources for traditional purposes. The assessment of these aspects includes a 5 km radius from the Project Area in terms of physical effect directly on Indigenous Peoples. In a broader socio-economic sense and in terms of potential or established Aboriginal or treaty rights, title and related interests, the Province of Nova Scotia forms the spatial boundary.	Construction phase, operational phase, and decommissioning and reclamation phase.	The predicted residual environmental effects of the Project on the Mi'kmaq of Nova Scotia are assessed to be adverse but not significant after mitigation measures have been implemented.	Yes	Effects may accumulate at the regional level. The RAA is therefore chosen as the appropriate boundary. This is the same as the project boundaries.	Effects can be long lasting. Boundary set from beginning of mining and forestry in the region, with effects potentially continuing into the future.
Physical and Cultural Heritage	X			The loss or destruction of heritage or archaeological resource material is a potential environmental effect of the Project. Based on the existing knowledge there is some small potential for the Project to interact with identified heritage resources that have been associated with historic mining at or near the site. The current project plan is to avoid said areas. If areas of heritage resources are to be impacted, further work will be undertaken to document these resources. If heritage resources are identified during construction or operation of the mine then all work will stop in the immediate vicinity until said resources can be further studied.	Construction phase	The predicted residual environmental effects of project development and production on physical or cultural heritage resources are assessed to be adverse, but not significant.	No. No other projects or activities with likely impacts to physical or cultural heritage sites within the PA.	Effects only considered cumulative if the affect the same physical or cultural heritage site. The spatial boundary is set at the level of the project area.	Effects can be long lasting. Boundary set from beginning of mining and forestry in the region, with effects potentially continuing into the future.
Human Health and Socio-Economic Conditions	X	X	X	Since the project site is remote, the spatial boundary for assessment of potential impacts to the local economy extends beyond the footprint of the project since there is no opportunity for the purchase or exchange of goods and services within that footprint. This spatial boundary, therefore, extends along Highway 224 to local centres Middle Musquodoboit and Sheet Harbour, and regionally to Halifax, Nova Scotia. The purchase of goods and services in the local affected area will be previously established with the development of the parent project at Touquoy, however, potential for additional services from the Sheet Harbour area may be apparent with the development of Beaver Dam. With respect to land and resource use, the spatial boundaries are considered to be the project footprint, the affected area of the project, and Halifax Regional Municipality (HRM). For tourism the spatial boundary is outside the affected area. The spatial boundary of assessment for hunting and fishing is within the project footprint, the affected area, and regionally which would include HRM, Guysborough and Colchester.	Construction phase, operational phase, and decommissioning and reclamation phase.	There are no significant adverse environmental effects anticipated on health and socio-economics, once mitigation measures are applied.	Yes	Effects may accumulate at the regional level. The RAA is therefore chosen as the appropriate boundary. This is the same as the project boundaries.	Same as for project effects.

8.4 Identification of Projects in the Area

Major industrial projects that have or are taking place within a 35 km radius of the PA are identified and described in the following sections. A preliminary assessment of the potential cumulative effects of these projects with the Beaver Dam Mine Project is presented. A summary of the identified projects and their potential cumulative effects can be found in Table 8.4-1.

8.4.1 Past Physical Activities

8.4.1.1 Past Mining Operations within the Beaver Dam Mine Project Area

The area has been subject to exploration and mining activity since gold was first discovered in 1868. Between 1871 and 1949, there were intermittent attempts to develop and mine the area, initially focused on the Austen Shaft area and later on the Mill Shaft area located approximately 1.2 km west of the Austen Shaft (Figure 2.1-5). The small Papke Pit located approximately 400 m west of the Austen Shaft was excavated in 1926; however, the majority of development was focused on a belt of quartz veins in greywacke and slates that was approximately 23 m wide where intersected from the Austen Shaft. Approximately 967 ounces of gold production is recorded for Beaver Dam between 1889 and 1941. From 1978 until 1988, several companies drilled a combined 251 diamond drill holes for 47,935 m. Some of these drill holes were completed underground via an exploration decline that reached a maximum depth of 100 m below surface. In 1987, a small open pit was also excavated in the Austen Shaft zone. Approximately 2,445 ounces of gold production was also recorded for Beaver Dam between 1986 and 1989. Between 2005 and 2009 two companies drilled a combined 153 diamond drill holes for 22,010 m and also completed several other exploration programs including an aeromagnetic survey, a till survey, and a follow-up reverse circulation drilling program for geochemical purposes. Atlantic Gold secured the mine site in 2014 and immediately executed an exploration program whereby 38 diamond drill holes for 7,810 m were completed over the proposed surface mine area with the goal of converting inferred resources to measured or indicated resources.

These past mining activities contributed to the disturbance and fragmentation of the habitat in the PA and may therefore have cumulative effects with the Beaver Dam Mine Project on said habitat, as well as on the birds and fauna that use it.

8.4.1.2 Past Forestry Operations

The area has been subjected to extensive logging activity over the past 150 years. The current condition of the Beaver Dam Mine footprint is disturbed and fragmented habitat based on significant timber harvesting, associated road building and yarding areas and historic mining activity. The PA contains a diversity of habitat types and landscape features, but has experienced a considerable amount of disturbance and habitat fragmentation as a result of historic mine operations, and current and historic timber harvesting practices. The level of disturbance within the mine footprint PA disproportionately affects uplands, over wetlands.

As past forestry activities contributed to the disturbance and fragmentation of the habitat in the PA, they are likely to have cumulative effects with the Beaver Dam Mine Project with regards to habitat and flora, as well as on the birds and fauna that live in the affected habitats.

8.4.2 Present Physical Activities

8.4.2.1 Touquoy Gold Project

The Touquoy processing and tailings management facility is being constructed as part of the Touquoy Project in Moose River Gold Mines, Halifax County, Nova Scotia. It is being developed on land owned by Atlantic Gold and NSDNR, and centered around 44° 59’ 05” N/62° 56’ 30” W (NAD83 CSRS), 504598.8 E and 4981254.9 N (UTM NAD 83 Zone 20).

The processing of ore and the management of tailings, which will begin with the operation of the Touquoy Project, will continue as part of the Beaver Dam Mine Project. The Touquoy Processing facility will be operational for an additional four years beyond the original production lifespan of 6 years for the Touquoy Project. This will result in four additional years of ore processing, water management, and tailings management and disposal. Ore extracted and hauled from the Beaver Dam mine site will be processed at the Touquoy processing facility once reserves at Touquoy have been exhausted.

All residual effects for the Beaver Dam Mine Project resulting from use of the Touquoy processing facility are therefore continuations of effects that began as part of the Touquoy Gold Project. The cumulative impacts must therefore take into account the extension of the temporal boundaries for the effects. Also, any such effects that are lasting could accumulate over time. Possible cumulative effects on the VCs are summarized in Table 8.4-2.

8.4.2.2 Current Regional Forestry Operations

Land surrounding the Beaver Dam mine site and majority of the haul road is primarily owned by Norther Timber Nova Scotia Corp. with some Crown land (Figure 2.1-1). Some portions of the haul road are also owned by Musquodoboit Lumber Co. Ltd., Prest Bros. Ltd., Prest Enterprises Ltd., and Forestex Limited. The woodlots on these lands are regularly harvested with clearcutting being a widespread practice throughout the RAA. Due to these operations, the RAA is a mosaic of forested habitats at different stages of regeneration, including some relatively undisturbed mature forest. Harvested wood is transported from the area by road. Most of the proposed haul road for the Beaver Dam Mine Project uses existing roads already used by the forestry industry.

Since these regional forestry operations take place throughout the region, including within the RAA, LAA and the PA (notably for use of the haul road), there is a potential for cumulative effects with the Beaver Dam Mine Project on the majority of the VCs (see Table 8.4-2).

8.4.2.3 Port of Sheet Harbour

The Port of Sheet Harbour is a deep water port located 23 km south of the Beaver Dam mine site on the coast of the Atlantic Ocean. The terminal consists of a 152 m wharf with a minimum draft of 10 m and is capable of handling ships of up to 214 m (Port of Sheet Harbour, 2017).

This facility has the capacity to handle aggregates and dry bulk, scrap metal and a variety of large bulky equipment such as neobulk marshalling and load out, fabrication modules including construction equipment and heavy lift project cargo, pipes and tubulars, boilers and transformers, and wind turbines (Port of Sheet Harbour, 2017).

Given the distance between the Port of Sheet Harbour and the Beaver Dam Mine, as well as the important differences in the types of activities and the potentially affected natural landscapes (coastal and marine as opposed to inland forest, freshwater bodies and isolated wetlands), no cumulative effects between the Port of Sheet Harbour and the Beaver Dam Mine Project are expected for any VCs.

8.4.2.4 Cooks Brook Sand and Gravel Pit

Gallant Aggregates Limited operates a sand and gravel pit in Cooks Brook, located approximately 29 km west of the Touquoy processing site. An eastward extension of the site was approved in 2013 and scheduled to commence that same year. The sand and gravel pit is approximately 500 m long by 250 m wide.

Given the relatively small scale of this operation and the distance between it and the Beaver Dam Mine Project, no significant cumulative effects between Cooks Brook Sand and Gravel Pit and the Beaver Dam Mine Project are expected for any VCs. The only possible cumulative effect is the small contribution of each project to the overall deterioration and loss of natural habitats at the regional scale.

8.4.2.5 ScoZinc Ltd.

ScoZinc Limited owns and operates a zinc/lead operation in Cooks Brook, approximately 31 km west of the Touquoy processing site. The footprint of this mine is approximately 1.6 km by 0.6 km.

The mine was first developed in the 1980s, but no active mining is currently taking place. ScoZinc Ltd. continues to monitor zinc and lead prices, the exchange rate between the Canadian and United States dollars, and the financing environment for the potential restart of the mine. ScoZinc Ltd. has all of the necessary permits to restart the mine, which is currently on care and maintenance.

Given the relatively small scale of this operation and the distance between it and the Beaver Dam Mine Project, no significant cumulative effects between the ScoZinc Ltd. mine and the Beaver Dam Mine Project are expected for any VCs. The only possible cumulative effect is the small contribution of each project to the overall deterioration and loss of natural habitats at the regional scale.

8.4.2.6 National Gypsum

National Gypsum operates a large quarry in Milford Station, approximately 36 km west of the Touquoy processing site. It is the largest gypsum quarry in the world and was first constructed in 1955 (National Gypsum 2015). The footprint of the quarry is approximately 2.5 km by 1.1 km.

Given the distance between it and the Beaver Dam Mine Project, no significant cumulative effects between the National Gypsum quarry and the Beaver Dam Mine Project are expected for any VCs. The only possible cumulative effect is the small contribution of each project to the overall deterioration and loss of natural habitats at the regional scale.

8.4.2.7 Murchyville Gypsum Quarry

A small, approximately 275 m by 200 m, gypsum quarry is located in Murchyville, 17 km west of the Touquoy processing plant. This quarry is not currently operational and is currently on care and maintenance.

Given the relatively small scale of this quarry and the distance between it and the Beaver Dam Mine Project, no significant cumulative effects between it and the Beaver Dam Mine Project are expected for any VCs. The only possible cumulative effect is the small contribution of each project to the overall deterioration and loss of natural habitats at the regional scale.

8.4.2.8 Tangier Gold Mine

The Tangier Gold Mine is located approximately 19 km south of the Beaver Dam Mine Project haul road. The footprint of this mine is approximately 500 m by 150 m, as measured on Google Earth.

The area of the Tangier Gold Mine has seen mining activity since the 1860s. The existing mine began its activities in the 1980s and is currently inactive. However, it was recently was purchased by Resource Capital Gold Corp and plans are being developed for re-opening the mine within the next 18 months. The planned activities are limited to mining as no processing is planned at this site. Processing would take place at the Dufferin Gold Mine (Resource Capital Gold Corp. 2017).

Given the relatively small scale of this operation and the distance between it and the Beaver Dam Mine Project, no significant cumulative effects between the Tangier Gold Mine and the Beaver Dam Mine Project are expected for any VCs. The only possible cumulative effect is the small contribution of each project to the overall deterioration and loss of natural habitats at the regional scale.

8.4.2.9 Dufferin Gold Mine

The Dufferin Gold Mine is located approximately 25 km east of the Beaver Dam Mine Project haul road. The footprint of this mine is approximately 375 m by 150 m.

Mining has been active in this area for more than a century. The site of the Dufferin Gold Mine began activity in the 1980s and has had sporadic development over the years. In 2014, the mine operated for a short period of time before closing. It is currently under the same ownership as Tangier Gold Mine and there are plans for re-opening to begin in 2017.

Given the relatively small scale of this operation and the distance between it and the Beaver Dam Mine Project, no significant cumulative effects between the Dufferin Gold Mine and the Beaver Dam Mine Project are expected for any VCs. The only possible cumulative effect is the small contribution of each project to the overall deterioration and loss of natural habitats at the regional scale.

8.4.2.10 Taylor Lumber Co. Ltd.

Taylor Lumber Co. Ltd. has operated a mill in Middle Musquodoboit since 1945. This site, located approximately 16 km northwest of the Touquoy processing site, includes a saw mill, a finishing plant, a pallet plant, a power plant, a dry-kiln, and a chipping plant. The power plant is a co-generation facility that burns biomass produced from their operation that provides power to their operation as well as to homes and businesses within a 30 km radius (Taylor Lumber, 2017).

Given the location, distance from Beaver Dam and the type of activity, no significant cumulative effects are expected between the great Taylor Lumber Co facility and the Beaver Dam Mine Project for any of the VCs.

8.4.2.11 Great Northern Timber

Great Northern Timber owns and operates a chip mill facility in Sheet Harbour, approximately 16 km southeast of the Beaver Dam Mine Project area. Great Northern Timber procures wood chips and roundwood fibre from industrial landowners, sawmills, Crown lands, Private land contractors and Private woodlot management organizations in Nova Scotia, Prince Edward Island, New Brunswick and Quebec.

Given the location, distance from Beaver Dam and the type of activity, no significant cumulative effects are expected between the great Northern Timber chip mill facility and the Beaver Dam Mine Project for any of the VCs.

8.4.2.12 Gaetz Brook Wind Farm

On October 3, 2013, Natural Forces Wind Inc. registered an Addendum to the Gaetz Brook Wind Project Registration Document originally submitted on July 17, 2013. The purpose of the project was to construct and operate a 2.3 MW wind project at a site in the community of Gaetz Brook, approximately 32 km southwest of the Touquoy processing site. The Gaetz Brook Wind Farm environmental assessment was approved on November 15, 2013 by the Minister of Environment. Since 2014, the site has included a single wind turbine located at the end of a 500 m access road.

Given the location, distance from Beaver Dam and the nature of the activity, no significant cumulative effects are expected between the great Gaetz Brook wind farm and the Beaver Dam Mine Project for any of the VCs.

8.4.3 Future Physical Activities (Certain, Reasonably Foreseeable or Hypothetical)

No major specific future projects were identified within a 35 km radius of the Beaver Dam PA. It is expected that the forestry industry will continue into the foreseeable future throughout the RAA. The mining industry could become more active if the price of minerals, notably gold, increases. This could hypothetically lead to the expansion of existing projects or the proposal of other new mining projects as exploration for mining is active in the region. However, it is expected that these would continue to be of similar scale to the existing sites and therefore have a relatively small footprint at the regional level.

Table 8.4-1 Potential Impacts of Physical Activities on the Valued Components

ACTIVITIES	Past Physical Activities	Present Physical Activities	Future Certain Physical Activities	Future Reasonably Foreseeable Physical Activities	Hypothetical Physical Activities	Atmospheric Environment	Surface Water Quality and Quantity	Groundwater Quality and Quantity	Wetlands	Fish and Fish Habitat	Habitat and Flora	Terrestrial Fauna	Birds	Species of Conservation Interest and Species at Risk	Indigenous Peoples	Physical and Cultural Heritage	Human Health and Socio-Economic Conditions
Past mining activities	x					No.	No.	No.	No.	No.	Yes. Long term disturbance and fragmentation of habitats.	Yes. Long term disturbance and fragmentation of habitats.	Yes. Long term disturbance and fragmentation of habitats.	Yes. Long term disturbance and fragmentation of habitats.	Yes. Long term disturbance and fragmentation of habitats.	No.	No.
Past forestry	x					No.	No.	No.	Yes.	No.	Yes. Long term disturbance and fragmentation of habitats.	Yes. Long term disturbance and fragmentation of habitats.	Yes. Long term disturbance and fragmentation of habitats.	Yes. Long term disturbance and fragmentation of habitats.	Yes. Long term disturbance and fragmentation of habitats.	No.	No.
Touquoy Gold Project		x				No. Residual effects of the Beaver Dam Project are primarily from the mine site and trucking on the haul road.	Yes. Possible cumulative effects from continued use of Touquoy processing facility.	Yes. Possible cumulative effects from continued use of tailing management facility.	Yes. Los of wetlands within the cumulative effects spatial boundaries.	Yes. Possible effects on water quality near the Touquoy processing site.	Yes. Local loss and disturbance of habitat.	Yes. Local loss and disturbance of habitat.	Yes. Local loss and disturbance of habitat.	Yes. Local loss and disturbance of habitat.	Yes. Local loss and disturbance of habitat.	No.	No adverse cumulative effects anticipated.
Current Regional Forestry Operations		x				Yes. Emissions from trucking and logging equipment along haul road and if logging within LAA.	Yes. Impacts on watercourses crossed by haul road. Potential effects if logging within LAA.	Yes. Potential for contamination due to accidents and malfunctions.	Yes. Logging impacts observed in wetlands within the PA.	Yes. Impacts on watercourses crossed by the haul road.	Yes. Effects on habitat quality at local and regional scales.	Yes. Effects on habitat quality at local and regional scales.	Yes. Effects on habitat quality at local and regional scales.	Yes. Effects on habitat quality at local and regional scales.	Yes. Effects on habitat quality at local and regional scales and on road safety from trucking on haul road.	No.	Yes. Cumulative effects on road safety from trucking on haul road.
Port of Sheet Harbour		x				No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
Cook's Brook Sand and Gravel Pit		x				No.	No.	No.	No.	No.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	No.	No.
ScoZinc Ltd.		x				No.	No.	No.	No.	No.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	No.	No.

Table 8.4-1 Potential Impacts of Physical Activities on the Valued Components

ACTIVITIES	Past Physical Activities	Present Physical Activities	Future: Certain Physical Activities	Future: Reasonably Foreseeable Physical Activities	Hypothetical Physical Activities	Atmospheric Environment	Surface Water Quality and Quantity	Groundwater Quality and Quantity	Wetlands	Fish and Fish Habitat	Habitat and Flora	Terrestrial Fauna	Birds	Species of Conservation Interest and Species at Risk	Indigenous Peoples	Physical and Cultural Heritage	Human Health and Socio-Economic Conditions
National Gypsum		x				No.	No.	No.	No.	No.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	No.	No.
Murchyville Gypsum Quarry		x				No.	No.	No.	No.	No.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	No.	No.
Tangier Gold Mine		x				No.	No.	No.	No.	No.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	No.	No.
Dufferin Gold Mine		x				No.	No.	No.	No.	No.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	No.	No.
Taylor Lumber Co. Ltd.		x				No.	No.	No.	No.	No.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	No.	No.
Great Northern Timber		x				No.	No.	No.	No.	No.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	No.	No.
Gaetz Brook Wind Farm		x				No.	No.	No.	No.	No.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	No.	No.
Continuation of forestry practices (certain)			x			No.	No.	No.	Yes.	Yes. Possibility of future effects on fish populations within the PA.	Yes. Long term disturbance and fragmentation of habitats.	Yes. Long term disturbance and fragmentation of habitats.	Yes. Long term disturbance and fragmentation of habitats.	Yes. Long term disturbance and fragmentation of habitats.	Yes. Long term disturbance and fragmentation of habitats.	No.	No.
New mining operations (hypothetical)					x	No.	No.	No.	No.	Yes. Possible but hypothetical effects if future expansion of mining with the PA.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	Yes. Small contribution to regional habitat loss and disturbance.	No.	No.

8.5 Cumulative Effects Assessment of the Valued Components

8.5.1 Atmospheric Environment

8.5.1.1 Analysis of Effects

8.5.1.1.1 Baseline conditions

Local ambient air quality

Total suspended particulate concentrations ranged from 1.7 to 41.7 µg/m^3, with the higher value being obtained at Location #2 during monitoring in June 2008. Results for the coarse particulate matter (PM_{10}) concentrations ranged from 7.1 to 13.1 µg/m^3, with the higher value also obtained at Location #2 during monitoring in June 2008. This monitoring station was located in a recently clear cut area, which may have contributed to higher particulate levels in comparison to the other locations. This area was resampled in 2014 (AN-2). The 2014 results for that area were 4.6 µg/m^3, well below the NSAQS. For all other sample locations, baseline TSP and PM_{10} concentrations were below the NSAQS.

To build upon the preliminary baseline sampling of select parameters and review of data collected from nearby NAPS stations that was completed as part of this EIS development, it is recommended that additional baseline sampling program be completed closer to the start of Project activities to obtain data that is more representative of baseline conditions in the area. Other activities in the area, such as forestry operations, have the potential to cause changes in air quality over the next five years prior to the start of the Project. Therefore, it is preferred to collect a full set of baseline air quality data (including total suspended particulates, $PM_{2.5}$, PM_{10}, SO_x, VOCs, and NO_x) prior to the start of construction.

Operational air data at the Touquoy facility will be collected throughout the approved construction and operations phases of the Touquoy facility, which will provide insight into the effects of the Touquoy project on air quality prior to the processing of Beaver Dam ore.

Regional ambient air quality

There were no exceedances of the NSAQS at the nearest stations for all contaminates. One exceedance of the CAAQS for $PM_{2.5}$ was reported for the Pictou Station. The Beaver Dam mine site is located in a relatively undeveloped rural region of Nova Scotia with infrequent industrial operations that would affect air quality. As the NAPS monitoring stations are located in areas with local industry for Pictou and Dartmouth, measured concentrations of contaminants would likely be lower at Beaver Dam. They would likely be similar to the Alyesford monitoring station; however, since there is also forestry operations near Beaver Dam, concentrations at the Alyesford station may be lower.

GHG Emissions

The Beaver Dam mine site is located in a relatively undeveloped rural region of Nova Scotia with infrequent industrial operations that would contribute to GHG emissions. Existing GHG emissions would be generated primarily through recreational vehicle usage, local traffic, and limited forestry operations. At the Touquoy Processing Facility, GHG emissions will be generated from light and mobile fuel combustion sources, as well as from the processing plant. Emissions generated from the Touquoy facility associated with the processing of Beaver Dam ore will include emissions generated from the processing plant, including the carbon reactivation furnace, the electrowinning cells, and the barring furnace (gold smelting), as well as mobile equipment sources. These emissions will continue to be monitored over the life of the Touquoy facility.

According to Environment and Climate Change Canada (2016b), the total GHG emissions from Nova Scotia were identified to be 16,600 kilotonnes CO_2e during 2014.

Ambient Noise

Sound level measurements for all sample locations, except for Location #1, met NSE Pit and Quarry criteria for all time intervals. Sample location #1 was approximately 10 feet from a hauling road that was in use during the monitoring period contributing to elevated noise level readings. Typical sound sources would include recreational vehicles, traffic on local roadways and contribution from existing forestry operations. The degree to which these sources would influence the existing noise levels would vary depending on the time of day and season.

At the measurement locations around the mine site, based on the 2014 values (AN# 1,2,3) the average value is 33 dBA ±. The dominant noise sources noted are natural, including birds, the movement of leaves, and possibly the odd vehicle on a logging road. The measurement locations at Beaver Dam Mines Road and Mooseland Road would be mostly from natural sources. Mooseland Road measurements are comparable to the Mine site. It is located on a little used gravel road. The Beaver Dam Mines Road is elevated and is near a paved highway with regular traffic. This road also passes through Beaver Dam IR and ambient sound will be the same as at the measured location.

Ambient Light

The Project site is in a very rural remote location. Ambient night time light conditions would be minimal and typical of an undeveloped rural area. The largest artificial lights sources in the Project area are from the nearest residences of the Beaver Lake Indian Reserve, and the occasional all-terrain vehicle. As part of the 2007 Focus Report for the Touquoy site, a background light study was conducted. At all locations where measurements were taken, ambient light measurements were under exposed, indicating ambient light levels were too low to be measured.

8.5.1.1.2 Effects of Proposed Project

Ambient Air Quality

Dust emissions are the primary atmospheric issue for the Beaver Dam mine site. Air-borne particulate matter will be generated during construction and operation phases of the Project. During operation, most of the dust will be generated at the mine site from crushing processes and trucking operations, and on the haul road from trucking operations.

Due to the proposed site operation and configuration, air emissions sources will be close to ground-level or below grade. There will likely be negligible impacts to the residential area due to the surrounding topography, the surrounding forested area, and the distance to the nearest residential area.

At the Touquoy mine site, dust will be generated at the crushing circuit and by service vehicles. Based on the 2007 Focus Report, dust generated during processing is anticipated to be minor. Air emissions generated from the Touquoy facility associated with the processing of Beaver Dam ore will include emissions generated from the processing plant, including the carbon reactivation furnace, the electrowinning cells, and the barring furnace (gold smelting), as well as mobile equipment sources. Air emissions will occur from the processing plant, including CO_2, ammonia, off-gassing of hydrogen cyanide, and nitrogen oxides. The contaminants are anticipated to be dispersed in the atmosphere to harmless concentrations immediately following release.

An Emissions Summary and Dispersion Modeling assessment was conducted to assess potential air releases to the atmosphere and their impact on the surrounding receptors. Based on the estimated maximum emissions scenario presented in the Focus Report, the predicted maximum ground level ambient air concentrations of all potential contaminants during full-scale operations of the Touquoy facility calculated from the air dispersion modeling were all well below applicable criterion at the three sensitive points of reception. Prevalent winds, ground cover and forested areas all will aid in further reducing emission levels. The Report demonstrates that the Touquoy facility operations under worse-case meteorological conditions will not adversely impact human health or the surrounding environment.

GHG Emissions

GHG emissions from Nova Scotia reported in 2014 were 16,600 kilotonnes CO_2e (ECCC 2016b). Based on the Project GHG assessment, in an average full year of operation of the Project (most GHG-intensive phase), the site would emit 30.34 kilotonnes CO_2e - approximately 0.18% of the reported 2014 GHG total for Nova Scotia. All phases for the life-of-Project would represent approximately 1% of the provincial one year total.

Based on the Project GHG assessment, in an average full year of processing of the Beaver Dam ore at the Touquoy facility (most GHG-intensive phase), the Touquoy processing facility would emit 6.79 kilotonnes CO_2e - approximately 0.04% of the reported 2014 GHG total for Nova Scotia. All processing for the life-of-Project would represent approximately 0.20% of the provincial one year total.

In an average full year of operation of the Beaver Dam mine (most GHG-intensive phase), including operation of the mine site, hauling of ore, and the processing of ore at the Touquoy facility, the Project facilities would emit 37.13 kilotonnes CO_2e - approximately 0.22% of the reported 2014 GHG total for Nova Scotia. All operation, hauling, and processing for the life-of-Project would represent approximately 1.25% of the provincial one year total.

Ambient noise

Sources of Project-related noise on the haul road may include heavy machinery and truck traffic during the construction and operational phases. The nearest permanent residential dwelling (5 km) is located in the Beaver Lake IR 17. This is located approximately 5 km south of the mine site and is separated from the mine site by forest and two topographic ridges. These ridges block direct views from the houses to all work areas. The surface mine is located in a topographic depression and the crusher is in a more elevated position; however, distance to any sensitive receptors would mitigate any effects. The likelihood of any dwellings in this rural area being occasionally impacted by sound from the mine site is very low. The majority of mining operations will occur in the pit well below ground surface thereby provide excellent noise shielding. The nearest point of the haul road to the Beaver Lake IR 17 is approximately 3 km. The haul road is currently in use for forestry activities and the activities on the haul road related to the Mine site will be similar in nature. The likelihood of the IR being impacted by sound from the haul road is also very low.

Further assessment of baseline monitoring before construction, during construction, and during mining operations will be conducted to ensure impacts are below the NSE guidelines and the Health Canada noise guidance which allows for an incremental increase in the percentage of highly annoyed population in the community to remain below 6.5% at sensitive receptors. Based on typical mining scenarios in rural regions of Nova Scotia, the predicted sound levels at the mine boundaries have the potential to exceed the noise goals during both daytime and evening operations. However, at 1 km from the mine the sound levels may be at or below the noise goals, with sound levels dropping towards the ambient levels with distance. Blasting events may provide a slight spike in the sound levels at distance for a brief period of time at the same time of day (daytime) once or twice a week.

Predicted noise impacts were estimated using a preliminary accoustical model. The model was undertaken to provide an order of magnitude estimation of the predicted noise from the crushing operation and haul truck travel along the haul road. Site specific topography and mine layout was used for the model; however, all mobile sources, equipment, and open pit operations were not included. The results are cumulative for the equipment that was evaluated. Additional monitoring could be undertaken in the future if required as part of the IA process.

Based on a review of the preliminary acoustical model, noise impacts from the mine site and the haul road, as a result of crushing and haul operations only, are below the most conservative NSE criteria of 55 dbA (applicable for the hours of 23:00 to 7:00) at a radius of approximately 500 metres from the mine site and the haul road. Beaver Lake IR 17 is located approximately 5 kilometres from the mine site and 3 km from the nearest point of the haul road. Based on the estimated noise levels related to crushing and hauling provided by the acoustical model, there will be no noise impacts on the Beaver Lake IR 17 due to operations on the mine site or the haul road. A predicted noise contour plot is provided on Figure 6.1-1.

At the Touquoy mine site, the primary source of noise during the processing of Beaver Dam ore will be the crushing circuit, CIL circuit, and service vehicles. All other processing equipment is located within the processing building. As indicated in the EARD, the maximum sound generated at the processing plant is 80 dBA, which attenuates to the background of 40 dBA over a distance of 500 metres. Based on an additional acoustic assessment conducted as part of the Focus Report, predicted values at the sensitive receptors ranged from 34.6 dBA to 42.3 dBA. All estimated values are below the NSEL daytime sound level criteria on the dBA scale. Predicted noise levels at Scraggy Lake and Camp Kidston were approximately 2 dBA greater than daytime values measured in the baseline study. The predicted sound level at the farthest sensitive receptor from the proposed site was 34.6 dBA, which is below the baseline value measured.

Ambient Light

The Beaver Lake IR 17 is located approximately 5 km south of the mine site and is separated from the mine site by forest and two topographic ridges. These ridges block direct views from the houses to all work areas. The surface mine is located in a topographic depression and the crusher is in a more elevated position; however, distance to any sensitive receptors would mitigate any effects. The lighting effects would have a lower impact although it could be more widely experienced, especially if moisture or particulate matter are present in the atmosphere. The resulting halo of light above the mine might be seen from many locations. Although evident and given the rural setting of the site, it is not considered that it would cause any significant visual impact, due to a combination of large viewing distance and the screening effects of topography and vegetative cover.

Ambient night-time light levels are not anticipated to increase along the haul road as a result of the Project. Ore will be hauled to the Touquoy Processing and Tailings Management Facility for approximately 12 to 16 hours per day during the operational phase. Highway truck traffic will not generally be present on the haul road during night-time hours.

As part of the 2007 Focus Report, a light impact assessment was conducted for the Touquoy mine site and included three sensitive receptors – Camp Kidston, located approximately 3 km from the open pit, the nearest full time residence, approximately 5 km from the open pit, and the Scraggy Lake area. Based on the light impact assessment report, the calculated light levels at each sensitive receptor were significantly below the limits recommended by the ILE guidelines. Illuminance values ranged from 5.87 E-02 lux to 2.94 E-01 lux, which are well below the Post Curfew value of 1 lux.

Background ambient light was not measurable; therefore, project light sources during full-scale operations at the Touquoy mine site will have an impact on the existing environment. However, predicted Touquoy project sources will be well below ILE guidelines at all three sensitive receptors and in essence will have illuminance values less than that produced by a full moon. The surrounding forest area will further inhibit the spread of light. Impacts from proposed lighting sources will therefore not negatively impact migrating birds, native species, or other sensitive receptors. Additionally, during the processing of Beaver Dam ore, ambient light sources at the Touquoy facility are anticipated to be less than those used during full-scale operations.

8.5.1.1.3 Effects of Other Projects in the Area

Ambient Air Quality, Noise and Light

The only other local activity with potential cumulative effects on air quality, noise and light is that of the local forestry industry. As this industry is ongoing in the region and has been for many decades, its effects on air quality, noise and light are already accounted for in the local baseline conditions. The largest effect noted from the baseline data was the measurement of the highest suspended particulate concentrations from a monitoring station located in a recently clear cut area. Though this highlights the relatively small spatial scale at which these effects are felt. A similar localized effect was noted at an ambient noise station located near an active hauling road.

GHG Emissions

The effects of GHGs are additive at the global level. In order to assess the cumulative effects of the Beaver Dam Mine Project, the emissions from the Project are compared to the total GHG emissions for Nova Scotia, which were identified to be 16,600 kilotonnes CO_2e during 2014 (ECCC 2016b).

8.5.1.1.4 Cumulative Effects on the Atmospheric Environment

Ambient Air Quality, Noise and Light

It is likely that forestry operations will occasionally coincide with those of the Beaver Dam Mine and cause greater disturbance to air quality and noise that these operations produce individually, especially along the haul road. However, such additive periods are likely to be limited in duration and frequency and are not expected to be significant.

Within the Project Area, the Beaver Dam Project is the main contributor to these effects since as they will be continuous throughout the life of the project. In the absence of the Beaver Dam Project, the effects would be smaller since they would be limited to localized sporadic effects from local forestry operations. The principal assumption behind this assessment is that local forestry practices will not change in any important way during the life of the Beaver Dam Project. This assumption is considered as having a low uncertainty.

GHG Emissions

Based on the GHG assessment provided in this document, all phases from this project would represent approximately 1.25% of the total GHG emissions for Nova Scotia. It is therefore considered that the proposed project contributes very little to the overall cumulative effects of regional industry to GHG emissions.

Given the small contribution of the Beaver Dam Project to total GHG emissions, the cumulative with and without the project are very similar. This assumes that GHG emissions in Nova Scotia will remain fairly stable over the life of the Project. Though there is some uncertainty on this as the reduction of GHG emissions becomes an increasingly sought after objective globally, there is good confidence in the fact that the Beaver Dam Mine will only contribute a small percentage for Nova Scotia.

8.5.1.2 Mitigation

Given the limited extent and intensity of the cumulative effects to the atmospheric environment, no mitigation measures beyond those already presented to mitigate Project effects (Section 6.1.7) are warranted.

8.5.1.3 Residual Cumulative Effects and Significance Assessment

A significant adverse effect to the atmospheric environment at the Beaver Dam mine site is defined as a repeated or sustained release of contaminants from the mine site or haul road to the atmospheric environment that exceeds the NSE Maximum Permissible Ground Level Concentrations listed in the Nova Scotia *Air Quality Regulations* and that exceeds the Canadian Ambient Air Quality Standards for fine particulate matter and ozone. A significant adverse effect to the atmospheric environment at the Beaver Dam mine site is also defined as repeated or sustained noise levels being emitted from the mine site or haul road that exceeds the NSE Pit and Quarry Criteria.

The residual cumulative effects on the atmospheric environment are considered to be adverse but not significant.

8.5.1.4 Follow up and Monitoring Programs

No additional follow-up or monitoring beyond that presented in Section 6.1.9 is warranted.

8.5.2 Surface Water Quality and Quantity Cumulative Effects Assessment

8.5.2.1 Analysis of Effects

8.5.2.1.1 Baseline conditions

Watersheds within the Spatial Boundaries

The Beaver Dam Mine Project lies within the West River Sheet Harbour drainage basin, which is directly east of the large Musquodoboit River Valley system. The watershed occupies an area of roughly 576 km^2, a moderately sized watershed in the Province. The West River Sheet Harbour drainage basin discharges to the West River and its tributaries, from north to south. Elevations within the catchment vary from approximately 135 to 165 masl in the headwater areas and gradually decrease to sea level at the final outlet located at Sheet Harbour. The West River Sheet Harbour and Tangier River Secondary boundary runs through center of PA along the haul road.

The three confirmed waterbodies within the mine footprint PA are Crusher Lake, located in the western section of the PA, Mud Lake, located in the northwestern corner, and Cameron Flowage, located within the northeast corner, near the location of the proposed open pit. Tent Lake and Kent Lake are outside the study area but may be affected by changes in wetlands upstream

There are sixteen (16) mapped watercourses, including two major rivers, the West River Sheet Harbour and the Morgan River that intersect the haul road footprint. Five small waterbodies are mapped west of Lake Alma. During field assessments, however, these waterbodies were confirmed to be wetland habitat.

Along the haul road, timber bridges and culverts of varying designs and conditions are used to cross watercourses at several locations. An initial assessment of the existing haul road identified 23 watercourse crossings including 20 culverts (for smaller watercourses) and 3 bridges (for watercourses that are between 6 and 13 m in width). The bridges were considered to be in good condition, while a large portion of the culverts were poorly installed (i.e., buried, caved in, plugged, hung, not present, water flowing through the road base and not the culvert). The overall poor culvert conditions has contributed to poor surface water quality conditions and obstructed fish passage.

Two main surface water systems flow through the area of the Touquoy processing and tailings management facility. One system flows from Square Lake through Fish River and the other flows from Long Lake and the New Dam Flowage through Moose River. Both surface water systems in the area discharge to Scraggy Lake, located south of the facility.

Water Quality

Water quality throughout the PA is characterized as relatively pristine, with very little influence from past mining activities, local industry, road salting, or local residents. Some localized influences from road work (culverts, ditching) or forestry use would have occurred historically (suspended solids for example) but these would be localized and short term variations. The majority of nutrients were below or slightly above detectable concentrations, indicating little to no influence from agricultural operations in the area.

At the Beaver Dam Mine site, aluminum and iron exceeded the CCME FWAL guidelines at all sampling locations during most sampling events; however, this is a common feature of surface water in Nova Scotia. Mercury was identified above the CCME FWAL guidelines at all sampling locations during the last sampling event in August 2015, and arsenic concentrations were identified above the CCME FWAL guidelines at SW-4A, SW-5, SW-6A, and SW-10. Arsenic concentrations were variable at all sampling locations, but were generally elevated in the summer months. Arsenopyrite, an iron arsenic sulfide compound, is common in the surficial and bedrock geology of the area. Lead, cadmium, and copper fluctuates in surface water at most sampling locations and at times slightly exceeded the CCME FWAL guidelines at SW-4A (cadmium), SW-6A (cadmium and copper), and SW-10 (cadmium, copper, and lead).

At the Touquoy site, aluminum and iron exceeded the CCME FWAL at all sampling locations with the exception of the sample collected from Scraggy Lake; however, this is a common feature of surface water in Nova Scotia. Arsenic concentrations fluctuated at all sampling stations, in particular in Moose River where in the summer (lower water flow) this metal was elevated above the CCME FWAL guidelines. Arsenopyrite, an iron arsenic sulfide compound, is common in the surficial and bedrock geology of the area. Lead, cadmium, copper, selenium, and zinc fluctuated throughout the year at most sampling locations and sometimes slightly exceed the CCME FWAL guideline. Mercury was detected at one location (SW8) at concentrations near the detection limit.

Water Quantity

The primary surface water drainage system through the Beaver Dam mine site flows northward from Crusher Lake to Mud Lake and then northeastward into Cameron Flowage that forms part of the Killag River. West Lake and Tait Lake, located northwest of the site, discharge into a series of tributaries that flow southward into Cameron Flowage. Several small, ephemeral tributaries of this water system are also present.

In addition to the major water system, a 16 ha headwater bog is located south of the mine site. The bog discharges south into streams, another wetland system, and into Tent Lake. There is also a surface water system that originates at an unnamed lake located south of the site that continues to flow south through Paul Brook and discharge into the West River Sheet Harbour.

The Beaver Dam Mine Site was divided into three separate catchment areas and one overall catchment area for the purpose of calculating the water balance for the PA. The three separate catchment areas represent two catchments that contribute flow from the PA to Mud Lake (approximately 165 ha and titled Catchment 1 and 2) and a catchment area that drain into an unnamed lake feature that discharges into Cameron Flowage (approximately 46 ha and titled Catchment 3). The overall catchment area represents the entire contributing drainage area to Cameron Flowage at the downstream side of the Beaver Dam mine site PA (approximately 3,790 ha and titled Catchment 4). The Beaver Dam mine site represents approximately 5% of the contributing drainage area to Cameron Flowage at the downstream side of the PA.

8.5.2.1.2 Effects of Proposed Project

General mining operations including the storage and handling of diesel, the use of ANFO for blasting, and the disturbance of soil and bedrock from site preparation, general construction, and operation of the surface mine has the potential to adversely affect surface water discharged from the Beaver Dam mine site.

In addition, disturbance of soil and bedrock through site preparation and construction, general maintenance including regrading and de-icing, and dust suspension from operation of the haul road has the potential to adversely affect surface water quality in streams and rivers crossing the haul road through culverts and under bridges.

Ore storage, management of tailings, surface water discharges, general management of waste and accidents or malfunctions at the Touquoy processing site all have the potential to affect water quality.

Standard pollution prevention measures will be adopted throughout the PA to prevent accidental spills. Runoff from the working areas of the surface mine will flow to sediment retention ponds. The ponds will allow the water to be reused on-site for dust control. Discharges to the environment will be sampled and tested to ensure the applicable discharge standards are achieved. Thus, the predicted residual adverse impacts on surface water are not expected to be significant

Stripping of vegetation and soils from the operational areas is expected to increase the mean annual runoff discharged from the site. Much of this will flow towards Cameron Flowage/Killag River as is currently the case. Given this, the impacts on nearby surface water resources and associated downstream aquatic ecosystems are not considered to be significant. Diversion of flows into perimeter ditches and sedimentation ponds will reduce flows. The impacts of any changes will be felt slowly as the mine development proceeds. Given that these potential changes in surface flow to the flowage are relatively minor, the impacts of these effects are not considered to be significant.

The Touquoy facility is currently under construction with full operation expected in Fall 2017. Tailings produced from processing Beaver Dam ore will be disposed of in the Touquoy open pit once this is fully exhausted of ore. Seepage from the deposited tailings will be recirculated through the processing facility in a closed loop during the period of processing Beaver Dam ore at the Touquoy facility. Once the Beaver Dam ore is finished being processed and the Touquoy pit begins to refill this recirculation will cease. Make up water requirements will be sourced from Scraggy Lake or other sources as per NSE approvals. The primary potential effect of the continued use of the Touquoy facility on surface water quality is the use of the exhausted open pit for tailings storage with possible seepage degrading surface water quality, and the potential for accidents and malfunctions. The Beaver Dam tailings will be managed in the exhausted Touquoy open pit mine. As originally planned in the approved Touquoy Gold Mine Project Reclamation Plan, the inflow of groundwater, surface flow and precipitation into the pit will naturally create a lake upon closure of the site.

The approved Touquoy Environmental Assessment stated that the pit would be allowed to fill naturally with water over a period of time through precipitation, surface flow and groundwater in-flow. No change to this method is planned following the deposition of Beaver Dam tails, except that the time frame for refilling will be shorter given the decrease in available volume taken by the tailings. There are no predicted or potential changes associated with physical aspects of the hydrology or hydrogeology for the Site.

There are potential impacts to surface water quality as a result of the storage of Beaver Dam tailings in the exhausted Touquoy open pit mine but it should be noted that these are restricted to the surface water in the exhausted pit only. The flooded pit will be a lake settling that is physically disconnected from the nearby Moose River.

Tailings will be subject to cyanide destruction at the process plant before flowing to the exhausted open pit. Previous works conducted during the Touquoy EARD and Focus Report identified that cyanide destruction to cyanate is proven 99.5% effective. Cyanate decomposes harmlessly. The majority of the residual cyanide reagent introduced to the tailings during ore processing will be degraded and hydrolyzed to carbon dioxide and ammonium during storage in the tailings pond. Similarly, this will be expected to occur for the Beaver Dam tailings being stored in the Touquoy open pit. Based on the results of testing conducted as part of the Feasibility Study, detoxification of the effluent will result in levels of copper and cyanide that are below the MMER limits (Ausenco 2015). Surface water quality data for the tailings management facility from the compliance program at Touquoy will be available to the AGC team. This will allow more refinement in the potential effects prediction for the Beaver Dam tailings deposition in the pit using over 7 years of data prior to the Beaver Dam tailings being introduced to the exhausted Touquoy pit.

Surface water quantity will be affected by the processing of the Beaver Dam ore at the Touquoy facility in that an additional period of surface water extraction will be required. The amounts for this surface water use and time period have been previously identified in this document. The use of surface water for industrial purposes is highly regulated in NS and involves a proponent making application to NSE and providing rationale for the use of the water and information on the lack of impacts associated with the water use. AGC is familiar with the process and will provide NSE with information associated with the extended water use period prior to the need for the extended period beyond the currently approved period for Touquoy operation.

8.5.2.1.3 Effects of Other Projects in the Area

Touquoy Gold Project

The effects of the Touquoy project on surface water include (CRA 2007):

- Reduced water quality from sedimentation/siltation, deposition of fines during construction, operation and decommissioning;
- Introduction of contaminants (e.g., nitrate) from blasting operations and pit dewatering;
- Contaminated effluent released into Scraggy Lake from the tailings and polishing ponds;
- Excessive water withdrawal from Square Lake; and
- Contamination of surface water from spills of hazardous materials stored on site during mine construction and operation.

In summary, assuming that the mitigation measures to control erosion and sedimentation are applied, significant adverse effects from construction and operation of the Touquoy Project are not anticipated on surface water resources. Water withdrawal from Square Lake will only occur during initial site set-up over a five month period and only periodically on an as-needed basis of such low volumes as to be negligible to measurable. For two months, six and three percent of the lake volume will be required. Therefore, no significant adverse effects on Square Lake aquatic resources are expected. The discharge of treated mine effluent is controlled by legislation under Environment and Climate Change Canada for metal mines. The effluent must meet the limits put in place to protect the aquatic environment and the effects monitoring program will ensure that operational discharges are compliant. Therefore, no significant adverse effects on fish resources from tailings effluent on Scraggy Lake are expected.

Local Forestry Operations

Forestry operations have been ongoing through the region for many decades. As such, the effects of these operations are included in the baseline conditions. Since the water quality throughout the PA is characterized as relatively pristine, these effects seem to be minimal to the water bodies affected by the Beaver Dam Mine Project. The noted exceptions are the poorly installed culverts along the pre-existing portions of the haul road.

8.5.2.1.4 Cumulative Effects on the Surface Water Quality and Quantity

The use of the Touquoy processing plant extends the period in which effects to the surrounding surface water may take place by up to 6 years (3 to 4 years of operation and 1 to 2 years for decommissioning and reclamation). However, with the application of the mitigation measures proposed for the operation of the site for both projects, the residual effects of both projects are predicted to be not significant. The cumulative effects of these two projects are therefore also expected to be not significant. There is some uncertainty as to the effects assessments for these projects. These are addressed through the monitoring and follow-up programs established for the Project (Section 6.3.9).

The additional effects of the Beaver Dam project to the water courses crossed by the haul road are not expected to be significant. However, adverse effects from the existing portions of the haul road have been observed with regards to poorly installed culverts. Adverse cumulative effects to water quality are therefore found for these affected waterways. As these effects have been directly observed there is little to no uncertainty surrounding them. These effects are already present, and are therefore identical with and without the inclusion of the Beaver Dam Project. In fact, the Beaver Dam Project gives an opportunity to improve the observed conditions.

8.5.2.2 Mitigation

As part of the design process associated with the new haul road, the proponent has committed to identifying culverts that are currently in disrepair and removing/upgrading them where required. This will be undertaken as part of the preparation of the haul road during the construction phase of the project.

8.5.2.3 Residual Cumulative Effects and Significance Assessment

A significant adverse effect to surface water quality along the haul road is defined as a repeated or sustained exceedance of the CCME FWAL criteria for Total Suspended Solids (TSS) in surface water samples collected in situ.

There is a potential for residual cumulative effects to all surface water systems along Haul Road. However, the proposed improvements to the culverts in disrepair should improve existing surface water conditions at the affected locations. Overall, the residual cumulative effects are considered to be not significant.

8.5.2.4 Follow up and Monitoring Programs

In addition to the follow-up or monitoring presented in Section 6.3.9, monitoring and follow-up of the upgrading of the culverts along the haul road will be undertaken. Monitoring will ensure that the culverts along the haul road are upgraded in accordance with best practices during the construction phase. Follow-up after construction will ensure that the culverts are stable, functioning properly and that water quality is not adversely affected.

8.5.3 Groundwater Quality and Quantity Cumulative Effects Assessment

8.5.3.1 Analysis of Effects

8.5.3.1.1 Baseline conditions

The site hydrogeology consists of a fractured rock aquifer system which is overlain by a thin till layer. These two hydrogeologic units are present on regional scale and extend beyond the limits of the Beaver Dam site. The degree of saturation of the till varies. A series of test pits installed at the site encountered groundwater a 0.6 m below ground surface (bgs) but this was close to a bog area and could be a perched water table. The water table was encountered at depth of 1.5 to 1.8 m bgs in several test pits but others were terminated on bedrock at depths of up to 4 m without encountering groundwater. Groundwater flow in the till probably mimics the topography, with recharge occurring in elevated areas and groundwater flowing towards and discharging into local surface water bodies. Test pumping of a well installed in the till indicates it has a hydraulic conductivity 1.5 10-2 centimetres per second (cm/sec). Transmissivity was calculated at 4.85 metres squared per day (m^2/day) and the long term safe well yield was estimated at 6.8 litres per minute (L/min).

The site is located in a rural area of Halifax County that is sparsely populated. The nearest domestic well is calculated to be 5.5 kilometres away from the site, up-gradient in a southwesterly direction at a residence along Hwy 224.

Results from Touquoy indicate that groundwater is slightly basic (pH from 7.02 to 8.08) with elevated hardness (45- 160 mg/L). Certain metals such as aluminum, arsenic, manganese, strontium and zinc are elevated relative to guidelines for drinking water in Canada but within ranges found in groundwater in Nova Scotia.

The actual volume of groundwater stored in the bedrock aquifer is small, and this reflects the relatively small primary porosity of these rocks. Some of the larger bedrock structures may be hydraulically connected to surface water bodies which may become sources of aquifer recharge under a mine dewatering scenario. Under ambient conditions, surface water contribution to groundwater at the Touquoy site would be very limited given the thickness, continuity and permeability of the confining till and the relative impermeability of the bedrock.

Given that the geology at Beaver Dam is similar to that at the Touquoy site, it is anticipated that similar hydrogeological conditions exist.

The 2015 Peter Clifton & Associates Ltd. report indicates that groundwater occurs at shallow depths at the Beaver Dam Mine site. Cameron Flowage is likely an area of groundwater discharge. The bedrock sequence forms a fractured rock aquifer system, and this is overlain by a thin aquifer in the till. The degree of hydraulic connection amongst the smaller bedrock fracture systems is probably poor to moderate, and the main zones that are capable of storing and transmitting relatively large amounts of groundwater would be the larger scale faults. The volume of groundwater stored in the bedrock aquifer is probably small, and this reflects the relatively small primary porosity of these rocks. Some of the larger bedrock structures may be hydraulically connected to surface water bodies which may become sources of aquifer recharge under a mine dewatering scenario.

8.5.3.1.2 Effects of Proposed Project

At the Beaver Dam Mine site, the main potential sources of effects to groundwater are:

- Existing settling pond dewatering.
- Watercourse and wetland alteration in preparation of construction.
- Surface mine dewatering to facilitate access to and extraction of ore.
- Accidents and malfunctions to include fuel and other spills, settling pond overflow, and an unplanned explosive event.

The main potential sources of effects to groundwater along the haul road are:

- Watercourse and wetland alteration in preparation of construction.
- Haul road construction.
- Haul road upgrades.
- Haul road maintenance and repairs, including salt.
- Accidents and malfunctions to include fuel and other spills, and a haul truck accident.

The Touquoy facility is currently under construction with full operation expected in Fall 2017. Tailings produced from processing Beaver Dam ore will be disposed of in the Touquoy open pit once this is fully exhausted of ore. Seepage from the deposited tailings will be recirculated through the processing facility in a closed loop during the period of processing Beaver Dam ore at the Touquoy facility. Once the Beaver Dam ore is finished being processed and the Touquoy pit begins to refill this recirculation will cease. Make up water requirements will be sourced from Scraggy Lake or other sources as per NSE approvals. The Beaver Dam tailings will be managed in the exhausted Touquoy open pit mine. As originally planned in the approved Touquoy Gold Mine Project Reclamation Plan, the inflow of groundwater, surface flow and precipitation into the pit will naturally create a lake upon closure of the site. The primary potential effect of the continued use of the Touquoy facility on groundwater quality is the use of the exhausted open pit for tailings storage with possible seepage degrading groundwater quality, and the potential for accidents and malfunctions.

The approved Touquoy Environmental Assessment stated that the pit would be allowed to fill naturally with water over a period of time through precipitation, surface flow and groundwater in-flow. No change to this method is planned following the deposition of Beaver Dam tails, except that the time frame for refilling will be shorter given the decrease in available volume taken by the tailings. There are no predicted or potential changes associated with physical aspects of the hydrology or hydrogeology for the Site.

There are potential impacts to groundwater quality as a result of the storage of Beaver Dam tailings in the exhausted Touquoy open pit mine. These potential impacts would be minor in nature and consist of groundwater quality changes within a short radius of the flooded pit. Tailings will be subject to cyanide destruction at the process plant before flowing to the exhausted open pit. Previous works conducted during the Touquoy EARD and Focus Report identified that cyanide destruction to cyanate is proven 99.5% effective. Cyanate decomposes harmlessly. The majority of the residual cyanide reagent introduced to the tailings during ore processing will be degraded and hydrolyzed to carbon dioxide and ammonium during storage in the tailings pond. Similarly, this will be expected to occur for the Beaver Dam tailings being stored in the Touquoy open pit. Based on the results of testing conducted as part of the Feasibility Study, detoxification of the effluent will result in levels of copper and cyanide that are below the MMER limits (Ausenco 2015). Additionally, based on work conducted in 2007 for the Focus Report, the surface water contribution to groundwater is considered to be limited in this area, due to a confining till layer and impermeable bedrock.

Groundwater quantity will not be affected by the processing of the Beaver Dam ore at the Touquoy facility.

The predicted residual environmental effects of Project development and production on groundwater are assessed to be adverse, but not significant. The overall residual effect of the Project on groundwater is assessed as not significant after mitigation measures have been implemented.

8.5.3.1.3 Effects of Other Projects in the Area

Touquoy Gold Project

The effects of the Touquoy project on groundwater include (CRA 2007):

- Increased erosion and sedimentation resulting from the construction and operation of the mine site;
- Potential changes to Moose River flow regimes associated with pit construction; and
- Potential groundwater contamination from the Tailings Management Facility.

The potential for groundwater contamination from the Tailings Management Facility is low. The groundwater table in the area is near surface which will inhibit inflow by maintaining a low flow gradient. In addition, the permeability of the tailings is quite low and a perimeter cut-off will be included in the design. This cut-off will be part of the low permeability zone within the perimeter dam that will be tied into the underlying low permeability clay or solid bedrock. Seepage through the tailings dam wall is expected to be low. The clay core of the dam will exhibit permeability in the 1×10^{-6} m^3/s range which will minimize the passage of tailings water through the dam wall. Tailings deposited along the inside of the dam wall will further reduce seepage. Any seepage which does occur will be captured in collection ditches and pumped back into the pond. For this reason, the impact of seepage on groundwater quality is expected to be negligible.

Local Forestry Operations

Forestry operations could have minor effects on groundwater quality as a result of accidents and malfunctions within the spatial boundaries of the cumulative impact assessment. However, they are not expected to have any predictable systematic effects.

8.5.3.1.4 Cumulative Effects on the Groundwater Quality and Quantity

No cumulative effects on groundwater beyond the specific Beaver Dam Project effects are expected and the mine site because of the lack of other activities affecting this VC at this location.

Contamination of the groundwater as a result of accidents and malfunctions connected to the use of the haul road are potentially cumulative between all users of this road during the life of the Beaver Dam Project. As the hauling of ore for the Beaver Dam Project is expected to be the main use of this road during the operation phase of the project and because there are no predictable systematic effects from the other activities, the cumulative effects along the haul road are not expected to be noticeably greater than those identified for the proposed project and are considered not significant. For this same reason, cumulative effects in the absence of the Project would be lower.

The Beaver Dam Project extends the duration and possible extent of the potential groundwater contamination at the Touquoy site. However, these effects are expected to be negligible. There is some uncertainty as to these effects. This uncertainty addressed through the monitoring and follow-up programs established for the Project (Section 6.4.9).

8.5.3.2 Mitigation

Given the low level of cumulative effects anticipated and the fact that they primarily result from the activities of the Beaver Dam Mine Project, no additional mitigation measures beyond those proposed for this Project in Section 6.4.7 are required.

8.5.3.3 Residual Cumulative Effects and Significance Assessment

A significant adverse cumulative effect on groundwater is defined as an effect that is likely to cause effects on groundwater quality or quantity. An effect on groundwater quality would include exceeding the applicable CCME groundwater quality criteria. Effects on groundwater quantity would include causing significant groundwater draw down, which would limit the ability of groundwater to recharge Cameron Flowage or affects to wetlands with reduced water due to groundwater movement to the pit area.

The predicted residual cumulative effects on groundwater are assessed to be adverse, but not significant.

8.5.3.4 Follow up and Monitoring Programs

No follow-up or monitoring program beyond the proposed compliance and effects monitoring program for the designated Project (Section 6.4.9) is warranted.

8.5.4 Wetlands Cumulative Effects Assessment

8.5.4.1 Analysis of Effects

8.5.4.1.1 Baseline conditions

A total of 63 wetlands were identified within the mine footprint and 116 wetlands were identified along the haul road footprint for a total of 179 wetlands. A description of these wetlands is given in Table 6.5-1. The majority (63%) of wetlands identified within the mine footprint PA were classified as swamps. Similarly, the majority of wetlands identified along the haul road were also classified swamp habitat (65%). There were several wetland complexes within the PA comprised of some combination of shrub and treed bog, swamp and fen habitat. Many of these extended beyond the PA boundaries.

In general, hydrological flow within wetlands present in the mine footprint PA initiates at the southern extent of the PA, at the division of three tertiary watershed boundaries. Larger wetland complexes straddle the watershed boundaries and act as the primary outflow water source for downgradient wetlands, watercourses and lower lying lakes. As is typical of these habitats in Nova Scotia, bog formations located on higher land have the ability to source water to more than one tertiary watershed.

Due to its extensive length, and intersection with seven separate tertiary watersheds, wetlands along the haul road PA vary between outflow wetlands located at headwater locations, throughflow wetlands which drain water toward lower reaches of the watersheds and some instances of wetlands within lower portions of the watershed. As is typical of the Nova Scotia landscape however, smaller isolated wetlands were also identified in all regions of all watersheds.

The functional assessments conducted for the 179 wetlands located within the PA determined that the overall watershed condition of the nine relevant tertiary watersheds is in a relatively unaltered state (Table 6.5-2). Urban/commercial development is not present within the watersheds, and as such, existing roads account for the impervious surfaces calculated within the watershed evaluation resulting in a range of 0% - 0.62% with the higher percentages being along the existing haul road. Therefore, condition is classified as low. Wetland habitat cover ranges from 3.40% to 22.19 % of the total land area of the watersheds. Four of the watersheds provide a high ability to contribute to floodwater protection (<10% wetland cover), all of which comprise the future haul road footprint. Moderate floodwater protection (10-20% wetland cover) is afforded by four watersheds (of which two comprise the future mine footprint, and two comprise the haul road footprint), and one watershed provides low floodwater protection (>20% wetland cover), and comprises the haul road footprint.

Most buffer areas surrounding the wetlands are highly vegetated. These wetlands and buffers generally offer high quality wildlife habitat and good water quality functions. Forestry activity was documented in habitat along the haul road and is also present surrounding the mine footprint PA. All wetlands assessed were determined to provide high plant community integrity as the plants are generally composed of native species characteristic of the wetland type with a very minor component of non-native species.

8.5.4.1.2 Effects of Proposed Project

Development of the mine and associated infrastructure including upgrades to the haul road, will cause direct and in-direct impacts to wetlands mostly within the construction phase of the Project. Direct impacts will be associated with clearing, grubbing, infilling and development of the mine and its associated infrastructure. Along the haul road, upgrading of the road (widening and new sections of road as needed) will account for the greatest impact to wetland habitat.

Expected direct impact extent as a result of Project activities during the temporal lifetime of the mine are described in Section 6.5.6. Within the mine PA, 34 wetlands will be completely altered and 17 will be partially altered, for a total impact area of 317,293 m^2. Within the haul road PA, 1 wetland will be completely altered and 62 will be partially altered, for a total impact area of 23,500 m^2.

Potential hydrological and water quality related in-direct impact types are also anticipated in the mine footprint and haul road PA. In addition, due to the nature of proposed activities (i.e. active construction site, presence of vehicles and construction equipment throughout), all wetlands identified within the PA have potential to be indirectly impacted as a result of accidents and malfunctions and vegetative and habitat impacts (i.e. invasives, vegetation removal etc.).

Within the mine site PA, areas of heightened risk of these in-direct impact types include wetlands (and associated watercourses) bordering Crusher Lake (i.e. Wetlands 4, 8, 10 and 11) due to them directly receiving water from up gradient wetlands and watercourses which are subject to alteration (i.e. headwater and throughflow wetlands). Similarly, Wetlands 20, 14 and 17, all of which act as throughflow wetlands that intercept water prior to it draining into Mud Lake, are also at potential risk of in-direct hydrological and water quality impacts as a result of up-gradient alteration activities. At the eastern extent of the mine footprint PA, alteration to Wetland 57, a headwater wetland, has the potential to in-directly impact its down-gradient aquatic receptors, which include Watercourse 14, the eastern extent of Wetland 59 and Wetland 61. At the southern extent of the mine footprint PA, alteration to Wetland 29 has the potential to in-directly impact lower lying portions of the same wetland system, as it extends beyond the southern mine footprint PA boundary.

Potential also exists for up-gradient hydrological alteration as a result of down-gradient hydrological alteration. Examples include altered outflow (i.e. faster or slower outflows due to mine site drainage infrastructure), causing either dewatering (drying hydrological trend) or flooding conditions in up-gradient wetlands. Locations within the mine footprint PA where this is considered a possibility include southern extents of Wetland 2 and southern portions of Wetland 57.

The potential for in-direct wetland impacts as a result of upgrading and new construction of the proposed haul road also exists. However, due to the limited alteration footprint to up-gradient wetlands from haul road infrastructure, and standard road construction mitigation methods that will be employed as part of the construction process, down-gradient, in-direct impacts are not expected.

There are no direct or indirect effects to wetlands anticipated to be caused by the processing of ore and the management of tailings from the Beaver Dam Mine Project.

8.5.4.1.3 Effects of Other Projects in the Area

Touquoy Gold Project

The development of the Touquoy Gold Project will result in the removal of the four wetlands and a small portion of a fifth wetland located within the proposed Project area (CRA 2007). This will result in the loss of 4.33 ha of wetlands on the Project site.

However, assuming that the proposed compensation and mine site reclamation mitigation measures are applied, and that existing site drainage conditions are maintained, the Touquoy Gold Project is not likely to have significant adverse effects on wetland functional attributes in the area.

Local Forestry Operations

Stressors relating to forestry activities were observed in several wetlands with the Project area (see Table 8.5-1). These stressors included clearcutting, rutting, roads and the presence of skidder tracks.

Table 8.5-1 Wetlands Stressors Related to Forestry Activities

Wetland ID	Project Area	Wetland size (m^2)	Direct impact area (Beaver Dam Mine Project)	Adjacent upland use	Stressors	Wetland Hydrology Altered?
6	Mine footprint	262	262	Forested	ATV trails	Old skidder tracks
12	Mine footprint	4,475		Forested	None, but some rutting and an old clearing	No
19	Mine footprint	11,428	2,211	Forested	Clear-cut	No
20	Mine footprint	10,106	10,106	Forested/ Road/ Trail	Culverts	Outlet has a culvert
21	Mine footprint	202	202	Forested	Ruts	Surface

Wetland ID	Project Area	Wetland size (m²)	Direct impact area (Beaver Dam Mine Project)	Adjacent upland use	Stressors	Wetland Hydrology Altered?
24	Mine footprint	328	116	Forested/ Clear-cut	Clear-cut	No
25	Mine footprint	1,416	1,416	Forested	Logging	No
28	Mine footprint	222	21	Forested	Logging	No
33	Mine footprint	1,900	1,900	Forested	Trenching	Ditching
34	Mine footprint	1,382	1,382	Forested/ Clear-cut	Rutting	No
35	Mine footprint	3,376	3,376	Forested	Road	Road/ Culvert
37	Mine footprint	253	253	Forested	Old skidder ruts	Surface
39	Mine footprint	1,857		Forested	Forest harvest	No
42	Mine footprint	1,879	1,857	Forested	Historic logging/ rutting	No
54	Mine footprint	416	416	Forested/ Road	Road	Road
56	Mine footprint	16,275	16,275	Forested/ Trails/ Road	Ditching, roads and some infill	Ditching
59	Mine footprint	65,348	63,432	Forested/ Roads	Drill pads, cutting, roads, flooding, beaver dam, and dead and dying woody plants	Ditching, dam and culvert
60	Mine footprint	2,963		Forested	Clear cut	No

Wetland ID	Project Area	Wetland size (m²)	Direct impact area (Beaver Dam Mine Project)	Adjacent upland use	Stressors	Wetland Hydrology Altered?
64	Haul road	15,979	159	Forested/ Road	Road	Road
65	Haul road	65	28	Forested/ Road	Road	Road
76	Haul road	10,405	354	Forested/ Road	Roads, culverts, and garbage	Roads and culverts (2)
84	Haul road	695		Forested/ Road/ Cut block	Rutting/ Clear-cut	Old cut block
87	Haul road	362		Forested/ Road	Rutting. Clear-cut	No
88	Haul road	417		Forested	Rutting	Rutting
89	Haul road	6,194	290	Forested	Rutting	No
90	Haul road	4,495		Forested	Logging road/ Ditching	Ditching
109	Haul road	1,606	253	Forested/ Road/ Cut block	Old cut block	No
145	Haul road	1,462	321	Forested/ Road	Road	No
146	Haul road	2,653	329	Forested/ Road	None	Road restricting outflow
148	Haul road	9,220	1,834	Forested/ Road	Rutting/ Road	No
149	Haul road	1,811	1,134	Forested/ Road	Rutting/ Road	Impoundment of water near road
150	Haul road	145	107	Forested/ Road	Road	No
151	Haul road	2,959	614	Forested/ Road	Road	No

Wetland ID	Project Area	Wetland size (m²)	Direct impact area (Beaver Dam Mine Project)	Adjacent upland use	Stressors	Wetland Hydrology Altered?
152	Haul road	2,046		Forested	Skidder tracks/ Clear-cut	No
154	Haul road	1,991	626	Forested/ Road	Road	No
155	Haul road	717	175	Forested	Road	No
156	Haul road	14,756	1,479	Forested/ Road	Road	No
157	Haul road	7,006	3,181	Forested/ Road	Road	No
158	Haul road	575	209	Forested/ Road	Road	Road
159	Haul road	1,995	700	Forested/ Road	Road	Beaver dam at outlet
161	Haul road	1,618	377	Forested	Rutting	Ditching
163	Haul road	1,107	329	Forested/ Road	Clear-cut/ Rutting	Rutting
165	Haul road	1,623		Forested	Road	Input from ditching
166	Haul road	68	68	Forested/ Road	Road	Ditching
167	Haul road	875	227	Forested/ Road	Road	No
169	Haul road	607	50	Forested/ Road	Log pile	Culvert at outlet
172	Haul road	229	48	Forested/ Road	Rutting/ Clear-cut	Ditching
173	Haul road	4,814	7	Forested	Skidder tracks	No
175	Haul road	611		Forested/ Road	Skidder tracks	No
177	Haul road	755		Forested/ Road	Road	No
Total		223,949	116,124			

8.5.4.1.4 Cumulative Effects on the Wetlands

The loss of wetlands from the Touquoy Gold Project (43,300 m^2) is cumulative with the wetland losses at the Beaver Dam Mine site (317,293 m^3) and along the haul road (23,500 m^2) for a total loss of 384,093 m^2. The vast majority of this loss (83 %) comes from the losses connected to the Beaver Mine footprint.

The total area of the wetlands in which stressors from other activities, of which forestry is the most important was observed to be 223,949 m^2. It is however important to note that the stressors are mostly of limited impact and are not equivalent to loss of the habitat. Of these 223,949 m^2, 116,124 m^2 are within the direct impact area of the Beaver Dam Mine or the haul road improvement works.

The total cumulative impacts on wetlands following the construction of the Beaver Dam Project are therefore a direct loss of 384,093 m^2 of wetlands and some signs of disturbance in wetlands covering an additional 107,825 m^2. In the absence of the Beaver Dam Project, the cumulative effects would be the 43,300 m^2 loss of habitat from the Touquoy Gold Project and the signs of disturbance on wetlands covering 223,949 m^2.

This assessment is based on the planned footprint of the project and the detailed assessment of the affected wetlands as presented in the baseline conditions. There is little uncertainty with regards to this information or as to the nature of the predicted effects (loss of wetlands within the Project footprint).

8.5.4.2 Mitigation

The proponent is committed to engaging in wetland compensation activities for the wetland loss associated with the Project as required by the provincial wetland alteration process (see Section 6.5.7). Wetlands compensation is also planned for the losses resulting from the Touquoy Gold project (CRA 2007). As these are the main sources of cumulative effects to wetlands, no additional mitigation measures are proposed.

The goal of the compensation activities is to achieve no net loss of wetland function.

8.5.4.3 Residual Cumulative Effects and Significance Assessment

A significant adverse cumulative effect is defined as an effect that is likely to cause a permanent net loss of wetland function.

Assuming that the proposed compensation measures are applied for both the Beaver Dam Mine Project and the Touquoy Gold Project and that they achieve their objectives, no significant cumulative effects to wetlands are expected.

8.5.4.4 Follow up and Monitoring Programs

A comprehensive wetland monitoring program is planned for the Beaver Dam Mine Project (see Section 6.5.7.1). It is expected that the Touquoy Gold Project's compensation program will also include monitoring and follow-up. As these two projects are the main sources of cumulative effects to wetlands, no additional monitoring or follow-up is proposed.

8.5.5 Fish and Fish Habitat Cumulative Effects Assessment

8.5.5.1 Analysis of Effects

8.5.5.1.1 Baseline conditions

Fish Habitat in the Touquoy Gold Project Area

The mine site layout has been designed to avoid direct impacts to watercourses and fish habitat. There is one exception: the treated effluent from the tailing management facility will be discharged via a manmade channel to Scraggy Lake. There are several watercourses in the vicinity of the study area. Moose River is the largest watercourse adjacent to the property; it flows along the western border. An unnamed tributary to the Moose River flows south through the property, between the pit and proposed tailing management area. A first order unnamed tributary to this latter tributary starts south of the proposed pit and flows southward. The catchment area for both of these small tributaries has been recently logged. Square Lake is located northeast of the property and it will be a water supply source for the mine site. Fish River drains Square Lake to Scraggy Lake and both lakes are part of the Fish River Watershed which flows west and then south into Lake Charlotte, eventually emptying into Ship Harbour. The Fish River Watershed river system is significant for trout, gaspereau and Atlantic salmon populations (CRA 2007).

The tributary to Moose River is very small north of the Mooseland Road and was dry for much of 2005 and 2006. Fish habitat is marginal, dependent on surface flow, and at flow levels observed in 2005 and 2006, expected to be limited to fish excursions during high flows. The culvert at the Mooseland Road was installed incorrectly and is hung, thus preventing fish passage during average and low flow conditions. From the wetland area, downstream there is limited potential for seasonal brook trout habitat. Two small juvenile brook trout were captured just downstream of the woods road (south of the wetland) (CRA 2007).

Moose River is a medium sized watercourse with good riparian (watercourse edge habitat) vegetation. Streamside vegetation consists of horsetails and rushes. Surveys conducted in 2005 found the section of Moose River adjacent to the study area provided habitat for a wide variety of fish species including Atlantic salmon and brook trout. Numerous juvenile Atlantic salmon were observed in the area, which provides good juvenile and rearing habitat and potential spawning habitat. It is likely that the salmon observed were landlocked specimens based on the vicinity to a known landlocked salmon population in Scraggy Lake and on the coloring and size of the fish captured. Moose River was also determined to be good adult and juvenile brook trout feeding habitat, fair rearing habitat and potential spawning habitat. Other fish species observed included American eel (*Anguilla rostrata),* white sucker (*Catostomus commersonii),* and minnow species (CRA 2007). .

Scraggy Lake is characterized by dozens of small coves and islands. The lake outlet is dammed and likely the cause for the high shoreline development value with a shoreline length of 52,558m. A fisheries resource study was undertaken in July 1975 by Nova Scotia Department of Agriculture and Fisheries. Gill netting and shoreline seining produced white suckers, white perch, brown bullheads, golden shiners, brook trout, American eel, lake chub, banded killifish and gaspereau. The latter species must bypass the dam at high water in spring. Atlantic salmon smolts were recorded in a 1979 creel census. Fingerling landlocked Atlantic salmon were stocked between 1998 and 2000. Brook trout were stocked between 1994 and 1996 (CRA 2007). .

Fish Habitat in the Beaver Dam Mine Project Area

Table 6.6-3 describes the fish habitat potential at each identified watercourse within the Project Area.

Eight of the fourteen linear watercourses as described in Table 6.6-3 within the mine footprint PA are classified as poor juvenile salmonid rearing habitat with no spawning capability. These streams would provide shelter and feeding habitat for larger, older salmonid (especially brook trout). WC4, located south of Crusher Lake, WC5 (lower portion) located north of Crusher Lake, and its tributaries (WC7 and WC9) are all classified as good salmonid rearing habitat with limited spawning, usually only in isolated gravel pockets, good feeding and holding areas for larger fish in deeper pools, pockets or backwater eddies (NFLD Guide). WC12, located west of Wetland 59 with direct connectivity to Cameron Flowage, also provides good salmonid rearing habitat with limited spawning potential. WC14, a small watercourse located south of Cameron Flowage, is classified as good salmonid spawning and rearing habitat; often with some feeding pools for larger age classes. However, although substrate and flow meet the requirements for this classification, its small size and average and expected low water depths limit potential for spawning within this tributary.

Mud Lake and Crusher Lake are classified as poor juvenile salmonid rearing habitat based on their sluggish flows, substrate and depth. These lakes primarily provide shelter and feeding opportunities for larger, older Brook trout. Cameron Flowage is classified as good salmonid rearing habitat with some limited potential for spawning. Overwintering could also occur within Cameron Flowage based on observed water depths.

Nineteen of the thirty four linear watercourses evaluated within the haul road PA are classified as good salmonid rearing habitat with some limited spawning opportunities. Four watercourses are classified as poor rearing habitat and no spawning potential. Watercourse E, located in the upper reaches of the Brandon Lake Tertiary Watershed on the north side of Cope Pond, is classified as good salmonid spawning and rearing habitat. Watercourse L is also located in the Brandon Lake Tertiary Watershed and is a tributary to the West River Sheet Harbour. This watercourse is also classified as good spawning and rearing habitat. The West River Sheet Harbour (Watercourse N) runs through the PA and is known to support all life stages associated with the Salmonidae family, including spawning. Watercourse Q is a tributary that drains directly to Lake Alma, in the Lake Alma Tertiary Watershed. Inside the PA, this watercourse was classified as good salmonid rearing and spawning habitat; however, this watercourse was observed to be subterranean downstream within the PA draining towards Lake Alma, which would act as a barrier to fish passage.

The Morgan River (watercourse AD) is located near the south end of the haul road PA in Eagle's Nest Tertiary Watershed. Like the West River Sheet Harbour, the Morgan River is also known to support all life stages of salmonids, including spawning. Its direct tributary, watercourse AH, located in the Rocky Lake Tertiary Watershed, is also good rearing and spawning habitat. The Morgan River is known to support white sucker, brook trout, white perch, yellow perch, banded killifish, rainbow trout, American eel, golden shiner, sticklebacks, alewife, northern redbelly dace, and brown bullhead (Alexander, Kerekes, & Sabean, 1986). The Atlantic Salmon Federation has indicated that the salmon is extirpated from the Tangier Watershed (https://www.asf.ca/main.html).

Table 6.6-4 describes the fish habitat present within each wetland and its associated watercourse in the mine footprint and haul road PA.

Twelve wetlands and associated watercourses have been evaluated to provide potential fish habitat based on the NL Guide for the salmonid family within the mine footprint PA. These wetlands are associated with the following surface water systems:

- Crusher Lake: WL8 and WL10
- Mud Lake: WL17
- Cameron Flowage: WL61, WL62
- Watercourse 5 (and smaller tributaries): WL8, WL14, WL17, WL44, WL46, WL52 and WL53
- Watercourse 3: WL4, WL20
- Watercourse 4: WL8, WL13, WL14, WL48
- Watercourse 11: WL29, WL33
- Watercourse 12: WL56, WL59

Most of these wetlands provide habitat that supports feeding, refuge and passage within and through the mine footprint PA surface water systems. Wetlands that provide potential overwintering and rearing habitat are associated with waterbodies and open water features on site. These wetlands include WL8 and 10 (Crusher Lake), WL17 (Mud Lake), WL29 open water section just south of the PA, WL44 (beaver impoundment), WL59 (previous dug waterbody for historical mining activities), and WL62 (Cameron Flowage).

Fish Species

Within the eight electrofishing locations in the mine footprint, a total of 44 individual fish were captured at five watercourse locations. The captured species were: Brook Trout (*Salvelinus fontinalis*), Ninespine Stickleback (*Pungitius pungitius*), Northern Redbelly Dace (*Chrosomus eos*), Banded Killifish (*Fundulus diaphanous*), Smallmouth Bass (*Micropterus dolomieui*), Lake Chub (*Couesius plumbeus*), slimy sculpin (*Cottus cognatus*) and Brown Bullhead (*Ictalurus nebulosus*). Additional fish collection with the mine footprint PA showed a relative abundance for the Banded Killifish of 42.9%, for the Golden Shiner (*Notemigonus crysoleucas*) of 35.7% and for the Brown Bullhead of 21.4%. Within Cameron Flowage the relative abundance of the Yellow Perch is 66.7%, Golden Shiner is 18.5% and the White Sucker (*Catostomus commersoni*) and Brown Bullhead are both at 7.4%.

Within the mine footprint PA, four species of commercial, aboriginal, or recreational (CAR) interest were confirmed, the Brook Trout, Yellow Perch, White Sucker and the Smallmouth Bass. No fish species at risk (SAR) or species of conservation interest (SOCI) were captured within the mine footprint PA during electrofishing surveys.

Within the seven electrofishing locations in the haul road PA, a total of 53 individual fish were captured. The captured species were: American Eel (*Anguilla rostrata*), Banded Killifish (*Fundulus diaphanous*), Blacknose Dace (*Rhinichthys atratulus*), Brook Trout (*Salvelinus fontinalis*), Golden Shiner (*Notemigonus crysoleucas*), Lake Chub (*Couesius plumbeus*), White Sucker (*Catostomus commersoni*) and Yellow Perch (*Perca flavescens*).

Within the haul road PA, four species of commercial, aboriginal, or recreational (CAR) interest were confirmed, the Brook Trout, American Eel, White Sucker and Yellow Perch. Two fish species at risk (SAR) or species of conservation interest (SOCI) were captured within the haul road PA during electrofishing surveys: the American eel (COSEWIC T) and the Blacknose dace (S3).

Benthic Organisms

Overall abundance and taxon richness within PA watercourses were low to moderate (110-947 individuals/sample and 10-31 taxon, respectively), and EPT ratios low at eight of the sites (0.5-8.4%) and moderate (16.1-50.2%) at the remaining sites (Watercourse N, V, AH, O). The occurrence of Mollusca at some of the sites, in addition to the EPT groups (Trichoptera, Ephemeroptera and Plecoptera) at most sites suggests that dissolved oxygen and water quality is acceptable, as these groups generally are associated with aquatic habitat having good water quality.

8.5.5.1.2 Effects of Proposed Project

Development of the mine will cause direct impacts to fish and fish habitat mostly within the construction phase of the Project during clearing, grubbing, blasting and development of the mine and its associated infrastructure. Continuing impacts to fish and fish habitat are possible during operations of the mine from on-going dewatering efforts within the open pit, and potential siltation and release of substances to downstream receiving surface water systems adjacent to the mine infrastructure. 8 wetlands and 2 watercourses that potentially or have been confirmed to support fish habitat will be completely altered (direct footprint impact). 8 wetlands and 3 watercourses that potentially or have been confirmed to support fish habitat will be partially altered (direct impact) as a result of mining activities and associated infrastructure associated with the mine footprint PA.

Construction of the haul road may cause impacts to fish and fish habitat mostly within the construction phase of the Project during clearing, grubbing and construction of new road components and road widening where necessary. 9 wetlands that are expected or confirmed to support fish habitat will be partially altered within the haul road PA to support road upgrades, widening and re-alignment as required. One wetland is known to support fish (Wetland 159) based on direct connectivity with Watercourse AA. The rest of the wetlands have been identified as potential fish habitat only. During construction, positive direct impacts to fish and fish habitat are also expected where current culverts that are hung or crushed can be either replaced or removed and fish passage and habitat re-established.

Potential hydrological and water quality related in-direct impact types are also anticipated in the mine footprint and haul road PA. In addition, due to the nature of proposed activities (i.e. active construction site, presence of vehicles and construction equipment throughout), all fish habitat identified within the PA have potential to be indirectly impacted as a result of accidents and malfunctions and vegetative and habitat impacts.

Potential impacts to surface water quality as a result of the storage of Beaver Dam tailings in the exhausted Touquoy open pit mine were examined, but it should be noted that these are restricted to the surface water in the exhausted pit only. The flooded pit will be a lake setting physically disconnected from other nearby natural surface water bodies. Due to this disconnection, potential for direct or indirect effects to fish or fish habitat are not anticipated due to the processing of ore and the management of tailings from the Beaver Dam Mine Project.

8.5.5.1.3 Effects of Other Projects in the Area

Touquoy Gold Project

The effects of the Touquoy Gold Project on Fish and their habitat are those summarized for the effects of the project on water quality. Overall, no significant adverse effects on fish resources from tailings effluent on Scraggy Lake are expected.

Local Forestry Operations

Forestry operations have been ongoing through the region for many decades. As such, the effects of these operations are included in the baseline conditions. Since the water quality throughout the PA is characterized as relatively pristine, these effects seem to be minimal to the water bodies, and therefore the fish habitat, affected by the Beaver Dam Mine Project. The noted exceptions are the poorly installed culverts along the pre-existing portions of the haul road.

8.5.5.1.4 Cumulative Effects on the Fish and Fish Habitat

Since the adverse effects observed with regards to the existing haul road will be reduced by the removal and replacement of the poorly installed culverts along this road and the Touquoy Gold project is not a source of significant adverse effects on fish habitat, no cumulative effects on fish habitat beyond the effects assessed for the Beaver Dam Project are anticipated.

In the absence of the Project, the conditions along the haul road are less likely to be improved. However the effects assessed for the Beaver Dan Project (Section 8.5.5.1.2) would be avoided.

There is some uncertainty as to the Project effects on fish and fish habitat. This uncertainty is addressed through the monitoring and follow-up programs established for the Project (Section 6.6.9).

8.5.5.2 Mitigation

No mitigation measures beyond those proposed in section 6.6.7 are warranted.

8.5.5.3 Residual Cumulative Effects and Significance Assessment

A significant adverse cumulative effect on fish and fish habitat is defined as an effect that is likely to cause serious harm to fish, as defined by Fisheries and Oceans Canada (DFO).

The predicted residual cumulative effects on fish and fish habitat are assessed to be adverse, but not significant.

8.5.5.4 Follow up and Monitoring Programs

As indicated in section 6.6.7, a fish and fish habitat monitoring program will be developed in association with requirements of wetland and watercourse alteration permits issued for direct wetland and watercourse alterations associated with the Project. Monitoring of surface water will also be completed which will support monitoring for potential impacts to fish and fish habitat. This monitoring program is described in Section 6.3.7.

8.5.6 Habitat and Flora Cumulative Effects Assessment

8.5.6.1 Analysis of Effects

8.5.6.1.1 Baseline conditions

The Beaver Dam mine site is bordered on all sides by forest in various stages of regrowth due to logging activities. Based on a visual review of a 2014 aerial photograph and the NSDNR Forest Inventory, approximately 78.6% of the PA is currently disturbed. Disturbed areas consist of clearcutting (4.6%), forested less than 40 years (51.3%), forested between 40 and 100 years (5.7%), mining and exploration activities (14.5%), and road corridors (2.5%). The remaining 21.4% of the PA is considered to be undisturbed wetlands (10.4%) and forests (11.1%) (NSDNR 2017).

Within the mine footprint PA, habitat survey points confirmed six different ecosites. Ecosites identified within the mine footprint PA were within the moist to fresh moisture regime, with poor to medium nutrient regimes. These ecosites generally support vegetation types from the Spruce-Pine and Spruce-Hemlock forest groups. Generally, Spruce-Pine forest groups are associated with a natural disturbance regime of fire, which leads to stands dominated by spruce, pine and understorey vegetation tolerant of acidic, nutrient poor condition. Spruce-Hemlock forest groups are characterized by Red Spruce (*Picea rubens*), White Pine (*Pinus strobus*) and Eastern Hemlock (*Tsuga canadensis*). These species have high shade tolerance and long lived species, which can support old growth conditions. Spruce-Hemlock forest groups generally do not support many species of rare plants, but provide good quality habitat for a diversity of mammals and birds.

A total of 294 species of vascular plants were identified throughout the PA. This represents moderate to high diversity, especially considering the low fertility of soils within the PA. The diversity of species is attributed to the range of habitat types encountered, from natural aquatic systems, a variety of wetland types, and both intact and disturbed upland habitats. The vegetation species observed are largely native species, with relatively low diversity and abundance of roadside exotic or invasive species. The species and communities of vascular plants encountered were typical given the eco-regional context, nutrient regimes, moisture regimes, and disturbance regimes. Of the 294 species identified, five are considered priority species.

Ericaceous shrub species such as Sheep Laurel (*Kalmia angustifolia*) and Black Huckleberry (*Gaylussacia baccata*) are frequent, along with other species which thrive in impoverished soil, such as Mountain Holly (*Nemopanthus mucronatus*), Wild Raisin (*Viburnum nudum)* and Black Spruce (*Picea mariana*). Where somewhat richer, finer soil till deposits are present, mixed wood to tolerant hardwood forests occur and include dominant species such as Yellow Birch (*Betula alleghaniensis*), Red Maple (*Acer rubrum*) and occasionally Large-toothed Aspen (*Populus grandidentata*).

Overall, understory vegetation layers are characteristic of low to medium soil fertility forest ecosystems described in Nova Scotia's Forest Ecosystem Classification system. Indicator species occurring in medium fertility sites include Northern Long Beech Fern (*Phegopteris connectilis*) and Christmas Fern (*Polystichum arctostichoides*), while species occurring in poorer conditions include Trailing Arbutus (*Epigaea repens*), Bracken Fern (*Pteridium aquilinum*) and Pink Lady's-slippers (*Cypripedium acaule*).

Common lichen species observed opportunistically during rare lichen surveys were recorded. A total of 20 species were recorded within the lichen study area (mine footprint, surrounding area, and haul road). Of these species, seven are listed as SAR or SOCI. While the specific habitat requirements of each of priority lichen species varies slightly, they all require mature to over-mature forests. Stand age is one of the greatest determinants of lichen diversity (McMullin, Duinker, Cameron, Richardson, & Brodo, 2008). Within the mine footprint PA and broader LSA, small to moderate scale disturbance is abundant in the form of timber harvesting, particularly to the north and east of the PA. However, where mature, intact natural stands within the mine footprint PA, forest stands support several rare species of lichen species. According to lichen specialist, Chris Pepper, the habitat along the haul road PA generally lacked over mature Red Maple and Balsam Fir required to support rare lichen species. This habitat is present within and surrounding the mine footprint PA, where forest stands supported a diversity of cyanolichen species. According to Mr. Pepper, the diversity and abundance of lichen species observed within the entire PA, including priority species is typical of similar habitats in this part of Halifax County.

8.5.6.1.2 Effects of Proposed Project

Development of the mine footprint and upgrading and construction of new sections of the haul road will result in direct impacts to vascular and non-vascular individuals, and to flora communities at the full or partial forest stand level. The effects of the Project on flora encompasses vascular and non-vascular flora in aquatic, wetland and upland habitats. As such, many of the effects specific to wetland habitat will directly relate to effects on flora. The majority of direct mortality to flora will occur during site preparation.

Movement of equipment during site preparation, operation and maintenance can result in deposition of dust on vegetation within close proximity of roads when conditions are dry. This affects flora through the deposition of dust on leaves, which temporarily reduces evapotranspiration and photosynthesis. Over time this may reduce overall growth rates. Similarly, winter maintenance of haul roads and site roads can affect plant growth adjacent to roads by placement of sand or stockpiling of snow. Road salt will not be used, thereby reducing potential impact to vegetation.

The likelihood of introduction of invasive species is elevated within the mine footprint, and along the entire length of the haul road, including the section of the Mooseland Road to the Touquoy Mine, where although no road upgrades are necessary, truck traffic will increase.

The level of new fragmentation associated with the mine footprint PA is anticipated to be moderate, given the current level of disturbance. Those species which prefer interior forest condition are likely already avoiding the mine footprint PA, while those species which prefer fragmented habitat are not expected to be adversely affected by additional habitat fragmentation. The majority of the proposed haul road follows an existing road, thereby limiting new habitat fragmentation. The section of road immediately southwest of Highway 224 will add new habitat fragmentation to an area that has very little, if any, evidence of anthropogenic disturbance. The construction of this section of the haul road will decrease the habitat quality for those species that rely on interior forest.

The Touquoy facility is currently under construction. Based on work completed as part of the 2007 Focus Report, lichens are not anticipated to be affected by the continued use of the Touquoy facility for the processing of Beaver Dam ore. Lichens are susceptible to air pollution, including deposition of contaminants in air emissions and particulate matter. It was concluded in the Focus Report that total suspended particulate from the processing facility at Touquoy will not have a significant adverse effect on any listed lichen species in the region.

There are no direct or indirect effects to flora or habitat anticipated to be caused by the processing of ore and the management of tailings from the Beaver Dam Mine Project. The use of the Touquoy facility for the processing of Beaver Dam ore will not involve construction of the mine site or any new disturbances, and as identified above, air emissions are not anticipated to have an adverse effect on flora; therefore, no effects are anticipated at the Touquoy facility related to the processing of Beaver Dam ore.

8.5.6.1.3 Effects of Other Projects in the Area

Touquoy Gold Project

Historical and ongoing forestry have already had significant effects on the vascular flora of the study site. Road and dwelling construction activities have also had significant impacts. Loss of habitat is the main potential adverse impact of the mine construction on plant species in the area. Potential impacts to plant species include removal of plants or alteration of their habitat (CRA 2007).

Reclamation of land disturbed by past or ongoing surface mining is an essential component of mitigating impacts to flora. Where reclamation is not complete and a landscape remains disturbed, terrestrial habitat (for both flora and fauna) is impacted in the long term. This long term impact can be successfully mitigated via reclamation of the site. Topsoil from the site will be stockpiled during the construction period for use in reclamation. The existing scrub plant material and debris will also be re-used in the reclamation as a growing medium placed as the final layer on top of the contoured lands. Excess organic material will be disposed of in appropriate locations (CRA 2007).

A good example of the rate of natural reclamation possible in the Moose River Gold Mines area is already present on the Project site. The proposed mine pit now exists as a small 0.45 ha test pit which was excavated in 1989. No reclamation or revegetation of this site was conducted. An area of 1.32 ha around the pit was devoid of vegetation in 1992, three years after the pit excavation. No data is available on how large an area was cleared in 1989 for the test pit excavation, although the presence of mature trees around the perimeter of the cleared area in 1992 suggests the boundaries of the vegetated area in 1989 and 1992 were essentially the same. By 2003, the area devoid of vegetation had been reduced to 0.22 ha, solely due to natural colonization and revegetation processes. Thus over 83% of the cleared area present in 1992 had been recolonized by natural processes alone in just over a decade. Thus, natural revegetation processes combined with an active reclamation plan which includes redistribution of native topsoil and organic materials should result in the reclamation period being significantly shorter (CRA 2007).

Local Forestry Operations

Large portions of the PA, particularly within the mine footprint, have undergone large-scale anthropogenic disturbance in the form of clearcutting, which has resulted in a much younger forest landscape with less valued, more shade-intolerant and opportunistic tree species.

8.5.6.1.4 Cumulative Effects on the Habitat and Flora

Although both the Beaver Dam Mine Project and the Touquoy Gold Project will cause the loss and disturbance of habitats within the PA, these effects are relatively small given the fact that most of the affected areas are already disturbed with the exception of the construction of the section of the haul road immediately southwest of Hwy 224. The new road construction will decrease the habitat quality for those species that rely on interior forest. The long term effects of the projects are reduced by the long term reclamation and remediation, which will involve re-vegetation of the mine sites at the end of their operation.

Overall, the generalized disturbance of the landscape by forestry activities, past, present and future are the main source of cumulative effects of habitats throughout the area. Without the Project, the loss of habitat in the Beaver Dam Mine footprint during the construction and operation phases would be avoided, however the generalized disturbance of the landscape would be unaffected.

The generalized disturbance of the landscape by forestry is well documented in the NSDNR Forest Inventory. There is little uncertainty with regards to this information or as to the nature of the predicted Project effects (loss of habitat within the Project footprint).

8.5.6.2 Mitigation

The relatively minor contribution of the Beaver Dam Mine Project to habitat loss is already strongly mitigated by the measures presented in section 6.7.7. The mitigation of the effects originating from local forestry management practices falls outside the scope of the Project proponent’s authority and responsibility.

8.5.6.3 Residual Cumulative Effects and Significance Assessment

A significant adverse cumulative on flora is defined as an effect that is likely to cause a permanent alteration to any flora species distribution or abundance.

Historical and current land use (forestry and mineral exploration) with the PA has undeniably negatively affected the local habitats in ways that have affected the local distribution and abundance of several species of flora. Follow up and Monitoring Programs

The monitoring and follow-up of the residual cumulative effects, primarily caused by past and ongoing forestry practices, falls outside the scope of the Project proponent’s authority and responsibility.

However, follow-up and monitoring of the site reclamation program for the mine site will need to be undertaken.

8.5.7 Terrestrial Fauna Cumulative Effects Assessment

8.5.7.1 Analysis of Effects

8.5.7.1.1 Baseline conditions

Mammals

Species observed incidentally within the Project area include Coyote (Canis latrans), Black Bear (*Ursus americanus*), White-tailed Deer (*Odocoileus virginianus*), Moose (*Alces alces americana*), American Red Squirrel (*Tamiasciursus hudsonicus*), American Porcupine (*Erethizon dorsatum*), Snowshoe Hare (*Lepus americanus*), Beaver (*Castor canadensis*), Chipmunk (*Tamias striatus*) and Raccoon (*Procyon lotor*). Other common mammal species such as Red Fox (*Vulpes vulpes*), Bobcat (*Lynx rufus*), Raccoon (*Procyon lotor*), Short-tailed Weasel (*Mustela erminea*), American Mink (*Neovison vison*), Muskrat (*Ondatra zibethicus*) and Striped Skunk (*Mephitis mephitis*) are likely to inhabit the Project Area or surrounding areas, at least periodically.

Moose

According to data provided by the ACCDC, Mainland Moose have been recorded within 4.7 km of the Mine Footprint, and within 14.1 km of the Haul Road. Tracking surveys were completed for the purpose of determining the presence of Moose within the Project Area (both mine footprint and haul road) as per methodology described above. Mainland Moose tracks were observed within the mine footprint PA during the dedicated PGI survey on May 24, 2015, in disturbed roadside habitat north of Wetland 56. Moose tracks were also observed incidentally in two locations just outside the mine footprint PA to the northwest on September 9, 2015.

Bats

According to the ACCDC reports, no known bat hibernaculae are present within 5 km of the haul road or mine footprint PA. The closest known bat hibernacula is located at the Lake Charlotte Gold Mine, approximately 25 km southeast of the intersection of the proposed haul road and Mooseland road (approximately 45 km from the mine footprint PA) (Moseley, 2007).

Herpetofauna

Species that have been observed, either directly or indirectly (through vocalizations, egg masses, cast snake skins, etc.) within the PA during the variety of field programs completed throughout the site include : Eastern American Toad *Bufo* (*americanus americanus*), Eastern Smooth Green Snake (*Lichlorophis vernalis vernalis*), Red-spotted Newt (*Notophthalmus viridescens viridescens*), Red-backed Salamander (*Plethodon cinereus*), Spring Peeper (*Pseudacris crucifer crucifer*), Bull Frog *(Rana catesbeiana*), Green Frog (*Rana clamitans melanota*), Northern Leopard Frog (*Rana pipiens*), Wood Frog (*Rana sylvatica*), Maritime Garter Snake (*Thamnophis sirtalis pallidulus*).

Though not observed, it is likely that other common herpetile species use habitat provided within the PA, at least periodically. These species include the Painted Turtle (*Chrysemys picta picta*), Mink Frog (*Rana septentrionalis*), Pickerel Frog (*Rana palustris*), Yellow-spotted Salamander (*Ambystoma maculatum*), Northern Red-bellied Snake (*Storeria occipitomaculata occipitomaculata*), and Northern Ring-necked Snake (*Diadophis punctatus edwardsii*).

The Snapping Turtle (*Chelydra serpentina serpentina,* SARA Special Concern, NSESA Vulnerable, S3) was not observed within the mine footprint PA. It was, however, observed within the vicinity of the Project Area, and along the current road to Moose River Mine within the haul road PA.

Summary of Fauna

The variety of both upland and wetland habitats identified throughout the PA support a range of terrestrial fauna. The PA is located in a relatively remote, undeveloped landscape. Timber harvesting and associated forestry roads form the dominant disturbance regime within the landscape surrounding the PA. This land use within and surrounding the PA has created edge habitats and openings in the canopy coverage to provide foraging opportunities for species such as White-tailed Deer, Black Bears and the Coyote. Evidence of these species, along with Showshoe Hare and Porcupine were abundant in disturbed habitats throughout the PA. Beavers and beaver activity has been observed in multiple waterbodies within the PA, particularly within Crusher Lake. All of the mammal species identified within the PA are presumed to use parts of the PA for foraging, breeding, denning and raising young, at least periodically.

Herpetofauna species were observed throughout the PA, generally in association with an aquatic ecosystem such as wetlands, waterbodies and watercourses.

8.5.7.1.2 Effects of Proposed Project

Development of the mine and associated upgrades to the haul road will cause direct impacts to habitat used by terrestrial fauna, including upland forested habitat and wetlands. This will occur mostly within the construction phase of the Project during clearing, grubbing and development of the mine and its associated infrastructure, and upgrading of the haul road (widening and new construction where necessary).

Aside from direct habitat loss within the mine footprint PA, the Project may affect terrestrial fauna through the increase in traffic along the haul road during operation. According to Fahrig and Rutwinski (2009), road construction can have relatively high negative impacts on amphibians and reptiles and large mammals, compared with small mammals and birds. Road infrastructure and traffic have a negative impact on those species which are attracted to roads, but lack the speed or cognitive ability to avoid traffic (i.e. turtles attracted to gravel roadsides for nesting). Small mammals and birds, on the other hand, are able to avoid collisions with vehicles in general. Amphibians in particular can benefit from culvert installation where wetlands and watercourses intersect roads, as an alternative to crossing the roads, because this group can experience high mortality (Bouchard *et al.*, 2009).

Road construction can decrease habitat quality through direct habitat loss, degradation and fragmentation (Underhill and Angold, 2000). For some species (i.e. Porcupine), the construction of a road can be beneficial by providing new foraging activities. Species that rely on interior forest condition (i.e. Fisher) are likely to avoid areas with new road construction, in favor of more undisturbed habitats. Local level changes in abundance and distribution of species may occur as the result of Project Activities, but it is not anticipated than any of these changes will result in changes in overall fauna populations. While some direct loss of habitat will occur, the PA is located in an undeveloped, natural landscape with a diversity of habitats. Habitat present within the PA is not unique or rare in the local or regional context.

Project activities are likely to result in increased habitat fragmentation, and a decrease in habitat quality for those species which rely especially on interior forest conditions, where intact interior forest remains. This decrease in habitat quality for species relying on interior forest condition is based on increased activity and sensory disturbance, along with increased physical fragmentation. Increase in physical fragmentation is expected to be low, based on current high level of disturbed habitat. However, one 4-km portion of new road construction is required. The section of road immediately southwest of Highway 224 will add new habitat fragmentation to an area that has very little, if any, evidence of anthropogenic disturbance. The construction of this section of the haul road will decrease the habitat quality for those species that rely on interior forest.

The effect of the Project on wildlife use can largely be attributed to sensory disturbance. Traffic volumes on the existing haul road are unknown and variable both seasonally and annually. Project activities will increase the traffic levels by an average of 20 trucks per day, for 12-16 hours of the day during the operational phase of the Project (an annual average of approximately 185 return truck trips per day). Additionally, blasting will occur 1-2 times per week within the mine footprint during the operational phase. This represents a considerable increase in sensory disturbance above current conditions, and will likely reduce the habitat quality for some species. The increase level of traffic poses an increased risk to wildlife collisions, particularly along the haul road, where the speed limit is proposed to be 70km/h.

The Touquoy facility is currently under construction. There are no direct or indirect effects to terrestrial fauna anticipated to be caused by the processing of ore and the management of tailings from the Beaver Dam Mine Project as no increase in footprint is proposed beyond the approved construction now underway.

8.5.7.1.3 Effects of Other Projects in the Area

Touquoy Gold Project

No critical areas for mammals such as deer wintering areas are known to exist in the Touquoy study area. Although the endangered mainland moose is present in the area, the site is not considered to be critical habitat for moose (CRA 2007).

Potential impacts to mammals could include direct mortality or disruptions with potential to affect populations such as loss of habitat, habitat fragmentation or significant disruption of migration or reproduction. Habitat loss may occur, if present, through site development and clearing activities. Habitat fragmentation in the local Project area is not expected to add significantly to existing habitat fragmentation in the local area. The area of the proposed mining and processing is currently intersected by an existing paved road, forestry roads and ATV trails. Similar habitat is extensive, surrounding the site to the extent of several hundred thousand hectares (CRA 2007).

The predicted slight increase in Project-related traffic is unlikely to cause adverse effects on wildlife, particularly moose, in the Tangier Grand Lake Wilderness Area (CRA 2007).

The main impact to amphibians and reptiles will be habitat loss. Amphibians in particular will lose habitat due to the removal of four wetlands on the study site. However, none of these wetlands contained suitable breeding habitat for amphibians, due to the lack of pools of standing water. No rare or endangered reptiles or amphibians are known to occur on the study site (CRA 2007).

Regional Forestry Operations and Other Historic Sources of Disturbance

Habitat within the PA and surrounding landscape currently exhibits fragmented conditions based on historic mine operations, existing road and trail networks, and current and historic timber harvesting activity within, and adjacent to the PA.

The existing haul road is used by lumber trucks, but the level of traffic varies seasonally and annually depending on which areas are undergoing timber harvesting.

Other Regional Projects Contributing to Habitat Loss

Various projects having caused visible loss of wildlife habitat within the region have been identified. The approximate footprint of these projects, as assessed conservatively based extent of un-vegetated areas on recent Google Earth (Google Earth Pro 7.1.5.1557) images, is given in the following list:

- Cooks Brook Sand and Gravel Pit (125,000 m^2)
- ScoZinc (960,000 m^2)
- National Gypsum (2,750,000 m^2)
- Murchyville Gypsum Quarry (55,000 m^2)
- Tangier Gold Mine (75,000 m^2)
- Dufferin Gold Mine (56,250 m^2)

The footprints of these projects give a total of approximately 4 km^2 in an area of approximately 90 km by 40 km (3,600 km^2) that is almost entirely covered by forests, lakes and wetlands.

8.5.7.1.4 Cumulative Effects on the Terrestrial Fauna

The overall footprint of mining activities, including the Beaver Dam and Touquoy sites, is quite small in relation to the available wildlife habitat within the region. Therefore, no significant cumulative effects to terrestrial fauna at the regional scale are anticipated with regards to these activities.

Overall, the generalized disturbance of the landscape by forestry activities, past, present and future are the main source of cumulative effects to terrestrial fauna throughout the area. The largest adverse effects expected would be to species preferring undisturbed and unfragmented habitats. It should be noted that these effects are smaller than they would be in a landscape dominated by agriculture or urban development, which lead to a much greater, and often permanent, loss of natural habitat.

As the Beaver Dam Mine site only contributes to a minority portion of the overall mining activities footprint, and because these effects are considered small compared to the generalized disturbance of the landscape by forestry activities, the cumulative effects with and without the project would be very similar at the regional level.

The main assumption behind this assessment is that the overall patterns of land use in the region will remain unchanged in the foreseeable future. The generalized disturbance of the landscape by forestry is well documented in the NSDNR Forest Inventory. There is little uncertainty with regards to this information. Overall, the assessment is considered as having low uncertainty.

8.5.7.2 Mitigation

The relatively minor contribution of the Beaver Dam Mine Project to habitat loss is already mitigated by the measures presented in section 6.8.7. The mitigation of the effects originating from regional forestry and land management practices falls outside the scope of the Project proponent's authority and responsibility.

8.5.7.3 Residual Cumulative Effects and Significance Assessment

A significant adverse cumulative effect on terrestrial fauna is defined as an effect that is likely to cause a permanent alteration to any fauna species distribution or abundance at the level of the regional population.

Historical and current land use in the region has likely affected the local habitats in ways that have affected the local distribution and abundance of several species of fauna.

8.5.7.4 Follow up and Monitoring Programs

The monitoring and follow-up of the residual cumulative effects, primarily caused by past and ongoing forestry practices, falls outside the scope of the Project proponent's authority and responsibility.

No additional monitoring beyond that indicated in section 6.8.7 is proposed.

8.5.8 Birds Cumulative Effects Assessment

8.5.8.1 Analysis of Effects

8.5.8.1.1 Baseline conditions

Beaver Dam Mine Project Area

Of the 100 avian species observed during dedicated surveys (i.e., fall migration, spring migration, and breeding, excluding incidentals) within the PA, 77 (75% of species) are protected under the *Migratory Bird Convention Act* (1994). Ninety-eight percent (98%) of all individual birds observed during dedicated surveys (i.e., fall migration, spring migration and breeding) are migratory birds.

Avian diversity was relatively higher along the haul road PA than within the mine footprint PA. This is likely attributable to the fact that the mine footprint PA is more extensively disturbed and fragmented as a result of historic mine operations and current and historic timber harvesting practices. Overall, avian diversity and abundance was moderate, and fell within expectations for the habitats available, and for forests in Halifax County in general.

Passerines were the dominant species group across all season within the PA, which is expected based on the variety of suitable habitats present within the PA. Non-passerine landbirds were the second most abundant species group observed within the PA and consisted primarily of grouse and woodpecker species. Habitats for these species are present throughout the PA.

No large congregations of waterfowl or shorebirds were observed roosting or staging within the PA during either the spring or fall migration periods. Wetland habitats suitable for migrating shorebirds and waterfowl were limited within the PA.

Raptors, both diurnal and nocturnal, were observed in low numbers within the PA throughout the year. Throughout the migrations period, this suggests that there are no major migration corridors over the PA. As for the breeding season, suitable breeding habitat is present for several forest raptors, including Northern Goshawk, Cooper's Hawk, Sharp-shinned Hawk, Red-tailed Hawk, Merlin, American Kestrel, Great Horned Owl, Barred Owl, and Northern Saw-whet Owl. Many of these forest raptor species are difficult to census; therefore it is not surprising that documented species richness and abundance were low within the PA.

Touquoy Gold Project Area

A total of 68 species were recorded from the Atlas of Breeding Birds of the Maritime Provinces (Erskine 1992) square for the Touquoy project (CRA 2007). Of these, 42 have been confirmed to breed in the area, while 9 are probable breeders and 17 are considered to be possibly breeding in the area. A total of 398 birds representing 52 species were recorded during the breeding bird survey of the 2005 study area. The most abundant species in descending order of abundance were Magnolia Warbler (7.5% of total) and Common Grackle (7.3%). Only two of the 52 species, Osprey (*Pandion halieetus*) and Willow Flycatcher (*Empidonax trailli*), were not presumed to be attempting to breed on the study site, although suitable Osprey nesting habitat is present along the nearby Moose River. None of the bird species recorded during the breeding bird survey is considered to be rare in Nova Scotia or particularly sensitive to anthropogenic activities (CRA 2007).

Two additional species were encountered during the 2006 wetland surveys; these were Pileated Woodpecker (*Dryocopus pileatus*) and Spruce Grouse (*Dendragapus canadensis*). Both are likely to breed in the habitat types present on site, and neither is listed as sensitive or at-risk in Nova Scotia. A Barred Owl (*Strix varia*) was also heard during a groundwater upwelling survey of the Moose River, near the location of the current Provincial Park, on Sept 13, 2006. In addition, the person who conducted the breeding bird survey is familiar with the area and has confirmed the presence of four owl species in the Moose River Gold Mines area in recent years (F. Lavender, pers. com 2007). The owl species are the Northern Saw-whet Owl (*Aegolius acadicus*), Great Horned Owl (*Bubo virginianus*), Barred Owl, and Long-Eared Owl (*Asio otus*). The Long-Eared Owl is yellow-listed in Nova Scotia and may use the Project site as suitable breeding habitat does exist (Fulton Lavender, pers. comm.) (CRA 2007).

8.5.8.1.2 Effects of Proposed Project

Habitat fragmentation resulting from clearing and grubbing of open pit, rock storage and new road construction may alter habitat suitability for those species which rely on interior forest condition. Within the haul road PA, this change in habitat is expected to be permanent.

Lights will be installed in active construction areas and on site facilities, including roads. This may cause disturbance or displacement of species, while attracting other species, or general behavioral changes. For those species which may be attracted to lights (i.e. insectivores), lights may increase potential for direct mortally of these species, or may increase habitat suitability by supplementing their source of prey. Birds may become attracted to or disoriented by open pit lighting at night, particularly during periods of migration, which could lead to mortality (Jones and Francis, 2003). Artificial lighting at night has been shown to influence the seasonal start of bird vocalizations, which could affect individual fitness (Da Silva et al., 2014).

Vehicle activity for transportation of personnel and operating supplies, as well as heavy machinery operation may cause bird injury or mortality.

Blasting (1-2 times per week) and drilling of in-situ rock during open pit mining, vehicle activity for transportation of personnel and operating supplies, and construction and commissioning of support infrastructure associated with mine infrastructure for crushing and haul-out will increase dust emissions, which may affect surrounding vegetation and, consequently, birds (Farmer, 1993).

Use of diesel-powered generators will cause noise that may disturb or displace birds from preferred habitats.

Migratory birds may be indirectly impacted as a result of the surface water quality in the shallow lake created in the Touquoy open pit mine, if they were to land in the water. However, water quality in the shallow lake is not anticipated to be affected by the deposition of Beaver Dam tailings. The majority of the cyanide reagent introduced to the tailings during ore processing will be degraded and hydrolyzed to carbon dioxide and ammonium during storage in the tailings pond. Similarly, this will be expected to occur for the Beaver Dam tailings being stored in the Touquoy open pit. Detoxification of the effluent will also result in levels of copper and cyanide that are below the MMER limits (Ausenco 2015). Mitigation measures will be applied to reduce the potential environmental impacts of the Project on migratory birds at the Touquoy facility as per existing approvals.

8.5.8.1.3 Effects of Other Projects in the Area

Touquoy Gold Project

Potential impacts to migratory birds could include direct mortality or disruptions with potential to affect populations such as loss of habitat, habitat fragmentation or significant disruption of migration or reproduction (CRA 2007).

Habitat loss may occur, if present, through site development/clearing activities. Habitat fragmentation in the local Project area is not expected to add significantly to existing habitat fragmentation in the local area. The area is currently intersected by an existing paved road and by forestry roads and ATV trails. Similar habitat is extensive surrounding the site to the extent of several hundred thousand hectares (CRA 2007).

The tailings management facility is not expected to have a significant adverse impact on migratory or breeding birds (CRA 2007).

Regional Forestry Operations

Habitat throughout the region exhibits fragmented conditions related to current and historic timber harvesting activity. This has led to habitat fragmentation and an increase in young regenerating stands to the detriment of older undisturbed forest.

Other Regional Projects Contributing to Habitat Loss

Various projects having caused visible loss of wildlife habitat within the region have been identified. The footprints of these projects give a total of approximately 4 km^2 in an area of approximately 90 km by 40 km (3,600 km^2) that is almost entirely covered by forests, lakes and wetlands.

8.5.8.1.4 Cumulative Effects on Birds

The overall footprint of mining activities, including the Beaver Dam and Touquoy sites, is quite small in relation to the available bird habitat within the region. None of these projects are expected to have direct effects on birds beyond their immediate surroundings. Therefore, no significant cumulative effects to birds at the regional scale are anticipated with regards to these activities.

Overall, the generalized disturbance of the landscape by forestry activities, past, present and future are the main source of cumulative effects to birds throughout the area. The largest adverse effects expected would be to species preferring undisturbed and unfragmented habitats. It should be noted that these effects are smaller than they would be in a landscape dominated by agriculture or urban development, which lead to a much greater, and often permanent, loss of natural habitat.

As the Beaver Dam Mine site only contributes to a minority portion of the overall mining activities footprint, and because these effects are considered small compared to the generalized disturbance of the landscape by forestry activities, the cumulative effects with and without the project would be very similar at the regional level.

The main assumption behind this assessment is that the overall patterns of land use in the region will remain unchanged in the foreseeable future. The generalized disturbance of the landscape by forestry is well documented in the NSDNR Forest Inventory. There is little uncertainty with regards to this information. Overall, the assessment is considered as having low uncertainty.

8.5.8.2 Mitigation

The relatively minor contribution of the Beaver Dam Mine Project to habitat loss is already mitigated by the measures presented in section 6.8.7 and direct effects to birds are mitigated through the measures presented in section 6.9.7. The mitigation of the effects originating from regional forestry and land management practices falls outside the scope of the Project proponent's authority and responsibility.

8.5.8.3 Residual Cumulative Effects and Significance Assessment

A significant adverse cumulative effect on birds is defined as an effect that is likely to cause a permanent alteration to any bird species distribution or abundance at the regional scale.

Historical and current land use in the region has likely affected the local habitats in ways that have affected the local distribution and abundance of several species of birds.

8.5.8.4 Follow up and Monitoring Programs

The monitoring and follow-up of the residual cumulative effects, primarily caused by past and ongoing forestry practices, falls outside the scope of the Project proponent's authority and responsibility.

No additional monitoring beyond that indicated for the Project in section 6.9.7 is proposed.

8.5.9 Species of Conservation Interest and Species at Risk Cumulative Effects Assessment

8.5.9.1 Analysis of Effects

8.5.9.1.1 Baseline conditions

Priority Fish Species

Within the mine footprint PA, no priority fish species were identified during any of the suite of survey methods. Priority fish species identified as having an elevated potential to be located within the Project Area, based on habitat preferences, and broad geographic range, include *Anguilla rostrata* (American eel), *Salmo salari* (Atlantic salmon), *Culaea inconstans* (Brook stickleback), *Osmerus mordax* (Landlocked Rainbow smelt), and *Rhinichthys atratulus* (Blacknose dace).

Two SOCI were identified during electrofishing within watercourses within the haul road PA. The American eel is currently listed as Threatened by COSEWIC. It was identified during electrofishing surveys in Watercourse N, V, and AH. A single Blacknose dace was observed in Watercourse N within the haul road PA as well. Atlantic salmon has been documented within the WRSH watershed and is expected to be present within contiguous surface water with the West River Sheet Harbour where suitable habitat is present within the haul road PA.

Priority Vascular Flora Species

Surveys of the Touquoy site did not detect any plant species of special status within surveyed area (CRA 2007).

During field assessments throughout the PA, a total of 294 species of vascular flora have been identified. No SAR vascular plant species were observed within the PA. Of the 294 species identified, five are priority species (SOCI), based on provincial status ranks (S3 and S3S4). These SOCI identified within the PA are outlined in Table 6.10-5.

Wiegand's Sedge (*Carex wiegandii)* was identified in three locations within the mine footprint PA. This species grows in a tuft formation in acidic peatlands, black spruce and larch bogs, and conifer and alder thickets. Within the PA, it was located in two wetlands and one nearby upland area.

Lesser Rattlesnake Plantain (*Goodyera repens*) is a small, inconspicuous member of the orchid family (Orchidaceae), found in coniferous forests throughout Nova Scotia. Within the PA, two individuals were identified on the upland edge of Wetland 29, in a coniferous forest, adjacent to recent timber harvesting.

Southern Twayblade (*Listera australis*, syn. *Neottia bifolia*) is a small inconspicuous member of the orchid family (Orchidaceae), which has been found in eight locations (Wetlands 80, 115, 129, 137, 135, 147 and 161, and in upland habitat north of WL136) within the PA. Its primary habitat is shaded sphagnum mosses in bogs or coniferous treed swamps.

Appalachian polypody (*Polypodium appalachianum*) is a member of the Polypody fern family (Polypodiaceae). Its habitat is restricted to cliffs, rocky slopes, bedrock outcrops and boulders. A population of approximately seven individuals was identified in upland habitat adjacent to Wetland 137 (a mixed wood treed swamp) within the haul road PA.

Highbush Blueberry (*Vaccinium corymbosum*) is an ericaceous shrub (family Ericaceae) in the Atlantic Coastal Plain Flora community. This species is usually limited to bogs, rock barrens and lakeshores around Digby and Queens Counties, but it can be found in other locations with remnant populations of Atlantic Coastal Plain Flora. Within the haul road PA, two individuals were identified in Wetland 157. This wetland is a treed swamp which is immediately adjacent to Upper Kidney Lake.

Priority Lichen Species

A total of six priority lichen species were observed within the broader lichen Survey Area as described in Section 6.10.3.3. Of the six priority species, three lichen SAR were observed, as well as three SOCI species; see Table 6.10-7. Of the 3 SAR identified, two are located within the PA. Blue Felt lichen was observed in the mine footprint and haul road PA and in the broader LSA, while Frosted Glass Whiskers was identified within the mine footprint PA. Boreal Felt Lichen was identified in the LSA, but not within the haul road or mine footprint PA.

Priority Mammal Species

The desktop evaluation for priority species of terrestrial fauna revealed that Mainland Moose (*Alces alces americanus)* has been documented within 5km of the Project Area by the ACCDC. Three records were available for Moose within 5km of the mine footprint PA, while the Mainland Moose was not documented within 5km of the haul road PA. The Mainland Moose is listed as endangered under the NSESA, and is provincially ranked as S1. Moose are known to occur in the general area of the proposed Touquoy mining area and Moose tracks were observed in a bog (Wetland 4) on the new study site in September and November 2006 (CRA 2007).

Nine (9) mammal priority species have elevated potential to be located within the PA, based on habitat preferences and known distribution. These include 6 bat species, Eastern Pipistrelle, Eastern Red Bat, Hoary Bat, Little Brown Myotis, Northern Long-eared Myotis and Silver-haired Bat, as well as the Maritime Shrew, the Rock Vole and the Moose (see table 6.10-8).

No bat hibernacula were identified within the mine footprint PA or within the haul road PA. Additionally, no potential bat hibernacula were identified through desktop evaluation within 10km of the PA.

Priority Herpetofauna Species

Wood turtles have been reported historically from the area of Moose River Gold Mines and are listed on the ACCDC database, however, the most recent record within 30 km of the site is almost 40 years old (CRA 2007).

The Snapping Turtle and the Wood Turtle have an elevated potential for being located within the PA based on broad geographic range and habitat preferences.

Targeted surveys for Wood Turtles within the mine footprint PA did not reveal any sightings of Wood Turtles or suitable nesting habitat. No opportunistic observations of Wood Turtles or suitable nesting habitat were documented during any wetland or watercourse surveys throughout the entirety of the PA.

Within the PA, no signs of Snapping Turtles were observed during any field programs. However, Snapping Turtles were observed opportunistically along roadsides in close proximity of the PA, and as a result of these observations and habitats present within the PA, they are anticipated to use some parts of the PA, at least periodically. Suitable habitat for Snapping Turtles has been observed in Wetlands 8, 10, 17, 29, 59, 61, 66, 68, 69, 159, 168 and 171. These wetlands all provide standing water to a depth exceeding 0.5m, As such, it is presumed that the open water portions of these wetlands provide overwintering habitat for snapping turtles.

Priority Invertebrates

Table 6.10-10 below provides a list of invertebrate fauna priority species which have elevated potential to be located within the PA, based on habitat preferences and known distribution. None of these species has been confirmed within the PA, though the Monarch (*Danaus plexippus*) has been observed in the10km x 10km Maritime Butterfly Atlas survey grid that covers Mud Lake and Crusher Lake, extending north to Beaver Lake, and east to Smith Lake and Rocky Lake.

Priority Birds

A desktop review for priority species revealed that (33) priority bird species were identified as having the potential to occur within the mine footprint and haul road PA based on habitat availability and geographic distribution (see Table 6.10-11). Eighteen species have been documented within 5km of the PA by ACCDC. During field assessments within the Project Area, a total of 25 priority bird species, seventeen SOCI and eight SAR, were observed. These species are presented in Table 6.10-12.

An additional five species considered SOCI in the breeding season (i.e., ACCDC only ranks these species with a breeding-status S-rank) were observed within the PA only during migration periods: Common Goldeneye, American Coot, American Kestrel, Brown-headed Cowbird and Pine Grosbeak. Though not observed during the breeding season, the desktop review for priority species found that the Wilson's Warbler and Pine Grosbeak (*Pinicola enucleator*) could be present within the Project Area during breeding season based on habitat availability and geographic distribution.

Common Nighthawks were not detected during the dedicated species surveys completed within the mine footprint PA in 2015; however preferred breeding habitat, specifically logged areas, peat bogs and forest clearings, were observed within the mine footprint PA. Suitable breeding habitats were observed within the haul road PA and four Common Nighthawks were observed during both breeding bird (n=1) and dedicated species surveys (n=3) in 2016. Common Nighthawk were observed within the haul road PA, in habitats with expansive gravelly areas adjacent to clear cuts or disturbed areas. There were no signs of breeding evidence (e.g., booming display) observed, but breeding is still possible as these birds were observed near suitable nesting habitat, specifically clear-cuts and gravel on expanded roadsides.

Two Peregrine Falcons were observed incidentally (n=1) and during the dedicated Fall Migration surveys (n=1) adjacent to the mine footprint PA, in 2014. Both observations were documented immediately north of the Mine Footprint PA, between Mud Lake and Cameron Flowage. Suitable breeding habitat was not present within the mine footprint or haul road PA.

Two Chimney Swifts were observed incidentally during the breeding season, in 2015, within the mine footprint PA. No suitable chimneys for roosting and nesting were observed within the PA and there were no signs observed of Chimney Swifts breeding.

Olive-sided Flycatcher observations were sparse, yet scattered across the mine footprint and haul road PA. Suitable habitat, including logged areas and forest edges near natural and human-made openings are present within the mine footprint and haul road PA. No evidence of breeding was observed, however 10 males were heard singing within the PA; during the 2015 Breeding Bird surveys within the mine footprint PA and incidentally within the haul road PA in 2016, suggesting possible breeding within the associated habitats.

The Canada Warbler's preferred habitat, moist mixed forests, was observed within the mine footprint PA as well as within the haul road PA. Sixteen Canada Warblers were observed during the 2015 and 1016 Breeding Bird surveys within the PA. Within the mine footprint PA, probable breeding behavior (i.e., agitated behavior and anxiety calls of an adult) was observed by one Canada Warbler, and possible breeding was exhibited by singing males during breeding season.

One Rusty Blackbird was observed incidentally within the mine footprint PA during the 2014 Fall Migration survey, in a large wetland complex to the northwest of the mine footprint PA (PC15). Breeding habitat, including forested wetlands, swamps and peatbogs are present within the mine footprint and haul road PA, however no evidence of breeding was observed.

One Barn Swallow was observed within the haul road PA during the 2016 Spring Migration surveys, near Wetland 159, between Hwy 224 and the mine footprint PA. Nesting habitat is available within the mine footprint PA and the haul road PA, particularly artificial structures including a cabin, bridges and road culverts. None were observed during the breeding bird surveys completed in the PA.

Two Eastern Wood-pewees were incidentally observed within the PA during the breeding season in 2016. One was identified at the outlet of Cameron Flowage, to the east of the mine footprint PA, while the second was observed incidentally within the haul road PA, east of Wetland 114. No breeding evidence was observed, although suitable habitat is present within the PA. As such, it is identified as a possible breeder.

8.5.9.1.2 Effects of Proposed Project

Priority Fish Species

Within the haul road PA, there are twenty four watercourses defined as Type 1 or 2 salmon habitat. American Eel were confirmed in three watercourses (watercourses N, V and AH). Thirty one watercourses within the haul road PA are determined to provide potential migration, juvenile rearing and/or overwintering habitat for American Eel. Construction of a 4km section of new road is expected to involve one watercourse crossing (WC O). Watercourse O provides juvenile rearing habitat for American Eel and WC-O provides Eel Migration habitat.

Construction of the haul road may cause impacts to fish and fish habitat mostly within the construction phase of the Project during clearing, grubbing and construction of new road components where necessary. During construction, positive direct impacts to fish and fish habitat are also expected where current culverts that are hung or crushed can be either replaced or removed and fish passage and habitat re-established.

Priority Vascular Flora and Lichens

Development of the mine footprint and upgrading and construction of new sections of the haul road will result in direct impacts to vascular and non-vascular individuals, and to flora communities at the full or partial forest stand level. The majority of direct mortality to flora will occur during site preparation.

Within the mine footprint PA, three of the seven documented locations of Frosted Glass Whiskers (*Sclerophora peronella)* are expected to be directly impacted, along with two of the three locations of Wiegand's Sedge (*Carex wiegandii)*, and the single location of Lesser Rattlesnake Plantain (*Goodyera repens)* by construction of the Waste Rock Storage Area. Three of the twenty-six observed locations of Blue Felt Lichen (*Degelia plumbea*) may be directly impacted by construction of a water diversion ditch (north of the open pit), the pit perimeter berm around the open pit, and the till stockpile. Impact to these individuals may be avoidable during the detailed design phase. The following species have been documented within close proximity to proposed infrastructure, and may be indirectly impacted by development: Frosted Glass Whiskers, *Sclerophora peronella* (4), Blistered Jellyskin Lichen, *Leptogium corticola* (3), Peppered Moon Lichen, *Sticta fuliginosa* (2) and Wiegands' Sedge *Carex wiegandii* (1).

Blue Felt Lichen, Highbush Blueberry, Appalachian Polypody and Southern Twayblade are species of non-vascular and vascular flora which have been documented in the haul road PA. None of these individuals are found along the proposed alignment for the upgraded haul road, or along the centerline of the section of new construction and an approximate 20m buffer. While detailed design of the haul road layout is not yet complete, it is not anticipated that vascular or non-vascular flora priority species will be directly impacted by upgrading the existing road, or by the construction of the new 4km section of the haul road.

Lichens are sensitive to changing environmental conditions, particularly air quality. As such, Project activities may indirectly affect priority lichen species which have been avoided, but exist in close proximity to Project infrastructure.

Priority Terrestrial Fauna

Development of the mine and associated upgrades to the haul road will cause direct impacts to habitat used by terrestrial fauna, including wetlands with suitable hibernacula for Snapping Turtles, and those with abundant submergent and emergent vegetation for Mainland Moose. Wetlands 8, 10, 11, 29, 59, 61, 66, 66, 68, 69, 159, 168 and 171 are identified as potentially providing hibernacula for Snapping Turtles where open water is present. The open water portions of Wetlands 8, 10, 11, 29 and 61 within the mine footprint PA are not proposed for direct impact. Wetland 59 has been identified as potentially providing hibernacula habitat for Snapping Turtles. This anthropogenic wetland will be directly impacted by construction of the open pit.

Sensory disturbance to terrestrial fauna would result from rock blasting (1-2 times per week during operation), clearing and grubbing, infrastructure construction during the construction phase and, overall increased traffic, blasting, mining activities and trucking during operations within the PA. This would likely result in localized wildlife avoidance of the PA, including Moose and Snapping Turtle.

Direct mortality of priority fauna species could result from Project activities, particularly due to the increase in traffic during construction and operation of the facility. Increased traffic poses a risk to wildlife such as the Mainland Moose and Snapping Turtle along the entire length of the haul road between the Beaver Dam mine and the Touquoy processing facility.

Priority Birds

With appropriate mitigation and monitoring, no direct mortality of priority bird species is anticipated, with the exception of the low potential for a bird strike with a haul truck. Avian usage of the PA during construction and operation of the Beaver Dam Mine will largely be driven by changes to habitat, resulting in localized avoidance of the PA by some species. Some priority species may avoid the PA, in favor of undisturbed habitat in the surrounding landscape. Other priority species are anticipated to be attracted to the mine infrastructure and newly created habitat.

The Common Nighthawk, for instance, is a crepuscular insectivore that nests on exposed gravel and disturbed areas. Lighting of buildings at dawn and dusk can create a foraging opportunity where insects are attracted to the lights. Barn Swallows commonly nest in the eaves of built structures, and Bank Swallows can nest in vertical slopes in sandy or silty soil, even in areas with high activity levels. These species of swallows have similar feeding habits as the Common Nighthawk. As such, Project activities may increase habitat suitability for both these species. If mitigated properly, the direct impact to these species is anticipated to be low.

8.5.9.1.3 Effects of Other Projects in the Area

Touquoy Gold Project

Some loss of moose habitat, although limited to the Project footprint, will occur. This area represents < 1% of the moose habitat available in eastern Halifax County, and habitat quality on the Project site is marginal. Potential impacts to moose may include direct mortality (vehicles), alteration or loss of habitat, disturbance of reproductive or feeding activities (generally due to noise or site activity), increased predation (natural predators, vehicle collision or hunting/trapping) due to improved access and traffic or disruption of migration patterns and habitat fragmentation. Accidental events could result in similar impacts. Vehicle use on-site could result in accidental mortality of moose. As few moose are in the area, it is unlikely that encounters will occur; however, the importance of individual moose within this herd is recognized. As collisions can be avoided by ensuring on-site vehicle speeds are under 50 km/hour, speed limits below this level will be enforced year round (CRA 2007).

No suitable habitat for any at-risk reptile or amphibian species has been encountered on the site of the Touquoy Gold Project (CRA 2007).

The environmental screening conducted by the NSM found no records of rare or endangered birds on the site of the Touquoy Gold Project (CRA 2007).

No rare or endangered vascular plant species as none have been observed on the site of the Touquoy Gold Project (CRA 2007).

Regional Forestry Operations

Habitat throughout the region exhibits fragmented conditions related to current and historic timber harvesting activity. This has led to habitat fragmentation and an increase in young regenerating stands to the detriment of older undisturbed forest.

The existing roads that service the regional forestry industry contribute to the disturbance and risk of collision to species such that the Moose. Poorly installed culverts along the pre-existing portions of the haul road were also noted as having adverse effects on fish that provide habitat for American Eel and Atlantic salmon.

Other Regional Projects Contributing to Habitat Loss

Various projects having caused visible loss of wildlife habitat within the region have been identified. The footprints of these projects give a total of approximately 4 km^2 in an area of approximately 90 km by 40 km (3,600 km^2) that is almost entirely covered by forests, lakes and wetlands.

8.5.9.1.4 Cumulative Effects on the Species of Conservation Interest and Species at Risk

Cumulative effects to SAR and SOCI are specific to each species, meaning that cumulative effects are only considered for species on which the Beaver Dam Mine Project has adverse residual effects and for which adverse effects from other identified projects in the area are expected.

Priority Fish

The cumulative effects to priority fish primarily result from the potential effects on watercourse as a result of road construction. Given that the adverse effects observed with regards to the existing haul road will be reduced by the removal and replacement of the poorly installed culverts, the final cumulative effects on American Eel and Atlantic salmon may be lower following the undertaking of the Beaver Dam Mine Project.

In the absence of the Project, the conditions along the haul road are less likely to be improved. However the effects the effects assessed for the Beaver Dan Project (Section 8.5.9.1.2) would be avoided.

There is some uncertainty as to the Project effects on fish and fish habitat, which includes effects on priority fish. This uncertainty is addressed through the monitoring and follow-up programs established for the Project (Section 6.10.7.1).

Priority Vascular Flora and Lichens

Several species of priority terrestrial plans and lichens may be affected by the Beaver Dam Project (see section 8.5.9.1.2). No other specific project with the area is known to have had direct effects on these species, but little information is available. The general habitat disturbances from historic and ongoing forestry activities are likely to have had some effect on species that prefer undisturbed habitat, such as the priority lichens.

There is a significant level of uncertainty as to the cumulative effects, especially as to the effects from past disturbances and other projects in the region. However, given the small footprint of the project on the regional scale there is some confidence that the Project's effects on priority flora contributes only a small portion to the total cumulative effects and that the cumulative effects with and without the project are similar in scale.

Priority Terrestrial Fauna

Both the Beaver Dam Project and the Touquoy Gold Project are expected to have some effect on the Mainland Moose. The effects are the result of loss of habitat and from the risk of collision with vehicles. Habitat loss and disturbance, and traffic from other activities in the region contribute to the resulting cumulative effects.

Similar cumulative effects are expected for the snapping turtle, though no other specific project causing loss of habitat for this species has been identified.

There is a significant level of uncertainty as to the cumulative effects on priority terrestrial fauna. Given the small footprint of the project on the regional scale there is some confidence that the Project's effects on priority terrestrial fauna contributes only a small portion to the total cumulative effects and that the cumulative effects with and without the project are similar in scale.

Priority Birds

No projects with important direct impacts to a priority bird species has been identified in the region. The cumulative effects to priority birds are therefore driven by habitat loss and disturbance and are essentially the same as those noted for birds in general. Overall, the generalized disturbance of the landscape by forestry activities, past, present and future are the main source of cumulative effects to birds throughout the area. The largest adverse effects expected would be to species preferring undisturbed and unfragmented habitats.

As the Beaver Dam Mine site only contributes to a minority portion of the overall mining activities footprint, and because these effects are considered small compared to the generalized disturbance of the landscape by forestry activities, the cumulative effects with and without the project would be very similar at the regional level.

The main assumption behind this assessment is that the overall patterns of land use in the region will remain unchanged in the foreseeable future. The generalized disturbance of the landscape by forestry is well documented in the NSDNR Forest Inventory. There is little uncertainty with regards to this information. Overall, the assessment is considered as having low uncertainty.

8.5.9.2 Mitigation

The contribution of the Beaver Dam Mine Project to the cumulative effect to potentially affected priority species is already presented in section 6.10.7. Mitigation measures to reduce effects to Moose are also planned for the Touquoy Gold Project (CRA 2007).

The mitigation of the effects originating from regional forestry and land management practices falls outside the scope of the Project proponent's authority and responsibility.

8.5.9.3 Residual Cumulative Effects and Significance Assessment

A significant adverse cumulative effect on SAR and SOCI is defined as an effect that is likely to cause a permanent alteration to a species' distribution or abundance, or alteration of critical habitat. Sedentary species such as vascular and non-vascular flora do not have the opportunity to move to avoid direct or indirect impact. For these species, the loss of a population of species that is important in the context of the Province, or that species' overall abundance or distribution, is considered significant. Mortality of a single SAR could, under some circumstances, be considered a significant effect.

Within the PA, the Beaver Dam Mine Project and the Touquoy Gold Project are not expected to have significant cumulative effects. However, the alteration of the disturbance of habitats throughout the region from historic and current land use is likely to have affected the local distribution and abundance of various species, especially those associated with undisturbed mature habitats.

8.5.9.4 Follow up and Monitoring Programs

No additional monitoring beyond that indicated for the Project in section 6.10.7 is proposed.

8.5.10 Indigenous Peoples Cumulative Effects Assessment

8.5.10.1 Analysis of Effects

8.5.10.1.1 Baseline conditions

There are currently 13 First Nations in Nova Scotia which are Mi'kmaq. A summary of these First Nations is provided in Table 6.11-1, as described by Aboriginal Affairs and Northern Development Canada's First Nations Profiles (AANDC 2017).

There are two First Nations (Mi'kmaq) reserves in the area of the Project. Beaver Lake IR 17 (49.4 ha) is located approximately 5 km from the mine site and 3 km from the proposed haul road. Sheet Harbour IR 36 (32.7 ha) is located 20 km south of the project. Both of these reserves are administered by the Millbrook First Nation in Truro, Nova Scotia. The 2016 Census reports twenty-one (21) people are living at Beaver Lake and twenty-five (25) people are living at Sheet Harbour (Statistics Canada 2017 and 2017a).

The Sipekne'katik First Nation located in Indian Brook, Nova Scotia is the second closest First Nations to the Project, located approximately 85 kilometres northwest of the Beaver Dam mine site. The 2016 Census reports that a total of 1,268 people are living on reserve at Indian Brook IR 14, New Ross IR 20, Pennal IR 19, Shubenacadie IR 13, and Wallace Hill IR 14A.

Historic Mi'kmaq Land and Resource Use

Based on the proximity of the Project site to watercourses and fish habitat, it is likely that the Mi'kmaq settled in the MEKS study area. Traditional use of the land in Nova Scotia involved permanent and semi-permanent settlements. In terms of hunting and gathering, the area contains a variety of spruce, fir, birch, ash, maple pine and shrubs inland, which would have been used in making baskets and building shelter. Fauna such as lynx, moose, beaver, deer, marten and hare were known to be drawn to the area; these animals were harvested for food by the Mi'kmaq.

The MEKS provides a description of Mi'kmaq use of land post-contact which is summarized as follows:

- In 1852, 100 acres at Beaver Dam was set aside on the Sheet Harbour Road at the head of Beaver Lake. Based on a survey in 1973 at Beaver Lake, it was found that the reserve contained 122 acres instead of the initial one hundred acres granted. The reserve was formally set-aside to Millbrook Band in 1960.
- In 1762, a proclamation was issued protecting the traditional hunting and fishing territories of Indigenous Peoples including a portion of Canso as far west as Musquodoboit. In 1783, a license of occupation was issued for 11,520 acres to protect fishing and hunting rights. Encroachment of European settlers occurred until the purchase of land to establish a formal reserve in 1915 at Sheet Harbour.
- In the first half of the 19th century, there is documentation of land laid out in the Ship Harbour area for Mi'kmaq individuals. As noted in the MEKS, the Mi'kmaq continued to use the area at Ship Harbour; however, the government wanted to centralize the Mi'kmaq on two main reserves at Shubenacadie and Indian Brook in 1919.

While there is no pre-contact archaeological activity recorded within the MEKS study area, it is noted that due to harsh winters, strong winds, and erosion, there is little evidence remaining of early Mi'kmaq use and occupation.

Current Mi'kmaq Land and Resource Use

The MEKS includes a study of current Mi'kmaq land and resource use sites, species of significance to Mi'kmaq, and Mi'kmaw communities. The following is a description of activities undertaken the following five categories that define current Mi'kmaq land and resource use:

- Kill/hunting: trout, eel, bear, rabbit, deer, porcupine, partridge, coyote, mink, muskrat, weasels, raccoon, fox, otter and beaver;
- Burial/birth: potential burial sites recorded within the MEKS study area on the western side of the Beaver Dam Mine Road but not within the Project area;
- Ceremonial: none identified

- Gathering: wild fruit, berries, water, food plant, specialty wood, logs, feathers, quills
- Habitation: anchored boat, travel route, overnight site

Species of significance to the Mi'kmaq are associated with three categories; these are listed below with the number of occurrences in the study area based on field work completed by CMM in summer 2016:

- Medicinal: 49 species present
- Food/beverage: 27 species present
- Craft/art: 11 species present

Consideration of Consultation and Engagement Results

Key issues raised during public consultation and Mi'kmaq engagement relating to Indigenous Peoples include potential habitat loss and effects on individual flora and fauna used in traditional hunting, fishing and trapping activities and medicinal food and plants.

Specific questions were noted on potential effects of accidents and malfunctions on the current use of traditional lands and associated contingency planning for any unplanned releases. Concerns included potential impacts to drinking water at the Mi'kmaq community of Beaver Lake and impacts to natural watercourses and receiving environments which may affect hunting, fishing and trapping activities. Concerns were related to health (including noise, air quality and safety, etc.) were expressed in terms of the originally proposed haul road as it was planned to pass Beaver Lake IR 17 along Hwy 224. These concerns were addressed by the Proponent's decision to construct 4 km of new haul road to avoid travel along Hwy 224.

From a socio-economic perspective, interest has been expressed by the Mi'kmaq of Nova Scotia to work toward benefit agreement(s) with the Assembly of Nova Scotia Mi'kmaq Chiefs, as well as the two nearest Mi'kmaq communities of Millbrook and Sipekne'katik which are not currently part of the Assembly.

8.5.10.1.2 Effects of Proposed Project

Many of the potential interactions above between the Project with the Mi'kmaq of Nova Scotia are via pathways of VCs that have been previously assessed as part of this EIS. This includes pathways for potential adverse effects to surface water, groundwater, wetlands, fish and fish habitat, habitat and flora, birds, fauna, SOCI/SAR, and human health. However, there are no expected indirect significant effects on the Mi'kmaq of Nova Scotia based on the effects assessment of the other VCs. This is based on the implementation of the mitigation and monitoring proposed for these other VCs.

With regards to direct effects to the closest Indigenous community at Beaver Lake, which is part of Millbrook First Nation, no effects on potable water quality, human health or socio-economic conditions are expected given distance from the Project Area.

The MEKS evaluated three potential impacts and evaluated their significance. These are noted below in context of the effects assessment:

- While it is acknowledged that Mi'kmaq archaeological resources are extremely important to the Mi'kmaq as a method of determining use and occupation and as an enduring record of the Mi'kmaq First Nation and culture across the centuries, the potential Burial sites are not located within the proposed Project site and there is a low likelihood of pre-contact artifacts as per the archaeological study, therefore, direct effect of the Project is not expected to be significant as per the MEKS.
- While plant species of significance to Mi'kmaq were identified within the MEKS study area, these same species also exist within the surrounding area. While the destruction of some specimens is a Project effect, it does not pose a threat to Mi'kmaq use of the species; therefore, permanent loss of some specimens of plant species of significance to Mi'kmaq is not expected to be significant as per the MEKS.
- As hunting, gathering and trapping activities were identified in the MEKS study area and permanent loss of habitat is an impact of the Project, the MEKS evaluated the potential habitat loss located in and around the wetlands and lakes as potentially significant; however, given the relatively small footprint of this Project, existing disturbance in Project Area and proposed mitigation, monitoring, and follow up associated with other VCs, the direct effect on hunting, gathering and trapping activities if expected to be minimal. No effect is expected on the areas where the majority of hunting gathering and trapping activities occur, i.e., Tent Lake and Cope Pond, Rocky, Otter, Como, Grassy and Beaver Lakes, the Killag River, the West River, and the West River Sheet Harbour.

There are no effects to Indigenous Peoples anticipated to be caused by the processing of ore and the management of tailings from the Beaver Dam Mine Project with the exception of the continued potential for accidents and malfunctions and continued environmental monitoring. No increase in footprint is proposed beyond the approved construction now underway, and therefore no direct or indirect effects to Indigenous Peoples are expected through proposed Project operations. Consultation and engagement with Indigenous Peoples will continue throughout the life of the Touquoy facility.

8.5.10.1.3 Effects of Other Projects in the Area

Touquoy Gold Project

As with the Beaver Dam Project, the main potential effects of the Touquoy Gold Project on Indigenous Peoples are indirect and caused by effects to other VCs:

- The effects of the Touquoy Gold Project on surface water, which can affect the use of surface water bodies and the fish inhabiting them by the Mi'kmaq of Nova Scotia, are presented in section 8.5.2.1.3. No significant adverse effects on aquatic resources are expected.
- The effects of the Touquoy Gold Project on groundwater, which could potentially affect drinking water of surface water bodies down-gradient, are presented in section 8.5.3.1.3, and are expected to be negligible.
- The effects of the Touquoy Gold Project on wetlands are presented in section 8.5.4.1.3. The project will cause a loss of 4.33 ha of wetlands, but is not likely to have significant adverse effects on wetland functional attributes in the area.

- The effects of the Touquoy Gold Project on habitat and flora, which can affect land and resource use as well as species of significance to the Mi'kmaq, are presented in section 8.5.6.1.3
- The effects of the Touquoy Gold Project on terrestrial fauna, which can affect their use, notably for hunting, by the Mi'kmaq of Nova Scotia, are presented in section 8.5.7.1.3.
- The effects of the Touquoy Gold Project on terrestrial fauna, which can affect their use, notably for hunting, by the Mi'kmaq of Nova Scotia, are presented in section 8.5.8.1.3 The tailings management facility is not expected to have a significant adverse impact on migratory or breeding birds (CRA 2007).
- The effects of the Touquoy Gold Project on SOCI and SAR are presented in section 8.5.9.1.13

Regional Forestry Operations

Habitat throughout the region exhibits fragmented conditions related to current and historic timber harvesting activity. This has led to habitat fragmentation and an increase in young regenerating stands to the detriment of older undisturbed forest.

The existing haul road is used by lumber trucks, but the level of traffic varies seasonally and annually depending on which areas are undergoing timber harvesting. The existing roads that service the regional forestry industry contribute to the disturbance and risk of collision to species such as the Moose.

Poorly installed culverts along the pre-existing portions of the haul road have been noted as having adverse effects on fish.

The traffic on the existing haul road by lumber trucks contributes to the overall risk of road accidents.

Other Regional Projects Contributing to Habitat Loss

Various projects having caused visible loss of wildlife habitat, and therefore loss of access to the habitats for traditional use by the Mi'kmaq of Nova Scotia, within the region have been identified. The footprints of these projects give a total of approximately 4 km² in an area of approximately 90 km by 40 km (3,600 km²) that is almost entirely covered by forests, lakes and wetlands.

8.5.10.1.4 Cumulative Effects on Indigenous Peoples

Adverse cumulative effects to surface water, which would cause effects on the use of surface water bodies and the fish inhabiting them by the Mi'kmaq of Nova Scotia, have been identified as a result of the poorly installed culverts along the haul road, see section 8.5.2.1.4. As these effects have been directly observed there is little to no uncertainty surrounding them. These effects are already present, and are therefore identical with and without the inclusion of the Beaver Dam Project. In fact, the Beaver Dam Project gives an opportunity to improve the observed conditions.

The cumulative effects on habitats, flora, terrestrial fauna and birds can lead to effects on current use of land and resources for traditional purposes:

- As indicated in section 8.5.4.1.4, the total cumulative impacts on wetland habitats following the construction of the Beaver Dam Project are a direct loss of 384,093 m² of wetlands and some signs of disturbance in wetlands covering an additional 107,825 m². The vast majority of the habitat loss (83 %) results from the Beaver Mine footprint. In the absence of the Beaver Dam Project, the cumulative effects would be the 43,300 m² loss of habitat from the Touquoy Gold Project and the signs of disturbance on wetlands covering 223,949 m².
- Although both the Beaver Dam Project and the Touquoy Gold Project will cause the loss and disturbance of habitats within the PA, these effects are relatively small given the fact that most of the affected areas are already disturbed with the exception of the construction of the section of the haul road immediately southwest of Hwy 224. The new road construction will decrease the habitat quality for those species that rely on interior forest. The long term effects of the projects are reduced by the long term reclamation and remediation, which will involve re-vegetation of the mine sites at the end of their operation. Overall, the generalized disturbance of the landscape by forestry activities, past, present and future are the main source of cumulative effects to habitats, flora, terrestrial fauna, and birds throughout the area. As the Beaver Dam Mine site only contributes to a minority portion of the overall mining activities footprint, and because these effects are considered small compared to the generalized disturbance of the landscape by forestry activities, the cumulative effects with and without the project would be very similar at the regional level. The main assumption behind this assessment is that the overall patterns of land use in the region will remain unchanged in the foreseeable future. The generalized disturbance of the landscape by forestry is well documented in the NSDNR Forest Inventory. There is little uncertainty with regards to this information. Overall, the assessment is considered as having low uncertainty.

All traffic on the haul road and any crossroads contribute to the risk of road accidents with the project area. The largest contributor to this traffic during the life of the project will be the trucking of ore from the Beaver Dam mine site to the Touquoy processing facility. Because the other sources of road traffic are much smaller, the cumulative effects are essentially the same as those of the proposed project. Without the Beaver Dam Project, the cumulative effects would therefore be smaller. The principal assumption behind this assessment is that local road usage will not change in any important way during the life of the Beaver Dam Project. This assumption is considered as having a low uncertainty.

8.5.10.2 Mitigation

To mitigate the adverse effects on the use of surface waters and the fish that inhabit them for traditional purposes, the proponent has committed to identifying culverts that are currently in disrepair and removing/upgrading them where required.

The proponent is committed to engaging in wetland compensation activities for the wetland loss associated with the project as required by the provincial wetland alteration process (see Section 6.5.7). Wetlands compensation is also planned for the losses resulting from the Touquoy Gold project (CRA 2007).

The mitigation of the effects on land use and resources for traditional purposes originating from regional forestry and land management practices falls outside the scope of the project proponent's authority and responsibility.

A potential adverse effect is related to a risk for mobile vehicle accidents along the haul road, in particular at the Hwy 224 crossing. Speed limit and right-of-way signage will be installed and all haul truck operators will receive operator training to minimize the risk of collisions. Intersection requirements and additional mitigation measures will be determined through discussions with NSTIR.

8.5.10.3 Residual Cumulative Effects and Significance Assessment

A significant cumulative effect is defined as a disturbance to or destruction of land and resources utilized by Indigenous Peoples, including potable water, surface water, fish, plants, and animals in the area of the mine site due to construction, operations, or accidents and malfunctions. A significant cumulative effect is also defined as a negative effect to health or socio-economic conditions for Indigenous Peoples.

Assuming that the proposed compensation measures are applied for both the Beaver Dam project and the Touquoy Gold Project and that they achieve their objectives, the predicted residual cumulative effects on Indigenous Peoples with regards to indirect effects from impacts to water quality, wetland habitats, and road safety, are assessed to be adverse, but not significant.

Historical and current land use with the region has undeniably affected the local habitats in ways that have affected the local distribution and abundance of several species of flora and fauna.

8.5.10.4 Follow up and Monitoring Programs

The monitoring and follow-up of the residual cumulative effects, primarily caused by past and ongoing forestry practices, falls outside the scope of the project proponent's authority and responsibility.

However, follow-up and monitoring of the site reclamation program for the mine site will need to be undertaken. In addition, it is expected that the development of benefit agreement(s) and implementation of the overall Mi'kmaq engagement strategy with regards to the Beaver Dam Project, see section 6.11.9, will include regular review of compliance and effects monitoring programs associated with other VCs, as well as monitoring of Project benefits to the Mi'kmaq of Nova Scotia.

8.5.11 Human Health and Socio-Economic Conditions Cumulative Effects Assessment

8.5.11.1 Analysis of Effects

8.5.11.1.1 Baseline conditions

The property is accessed by the Beaver Dam Mines Rd that is classed as a public right of way up to the mine site. Beyond that point roads are private resource roads developed by forestry companies to access the interior areas of the region. The network of roads is extensive and provides access to the public for recreational activity, namely for hunting, fishing and ATV use.

The haul road labeled as the Moose River Cross Rd is located through an area of managed forest by several forest companies and is part of a warren of logging roads. This road connects Highway 224 and Mooseland Road. There are no residences along this stretch of road. However, a couple of seasonal properties are located near the road near the western terminus with Mooseland Rd. This area also sees public use for access to hunting, fishing and ATV activity.

The haul road is a private logging road owned by the various land owners that include Northern Timber and the Province, and for the last 1.5 km owned by Musquodoboit Lumber Co. and Prest Bros. Ltd.

8.5.11.1.2 Effects of Proposed Project

There is low potential for the Project to cause adverse health and socio-economic conditions. The potential does exist for a mobile equipment accident along the haul road. Haul trucks will travel daily from the Beaver Dam mine site to the Touquoy processing and tailings management facility. The number of return truck trips per day will be an annual average of approximately 185 (370 one-way trips) for 12 or 16 hours per day, 350 days per year for the duration of the mine Project (3.3 years). During construction and pre-production (8 months), the number of trips will be less. The haul road will be dual lane and designed to facilitate the safe passage of two-way truck traffic at 70 km/h. Speed limit and right-of-way signage will be installed and all haul truck operators will receive operator training to minimize the risk of haul truck collisions. All intersections will be designed to NSTIR Standards. A haul truck accident may result in fuel and/or other spills, fires, and/or injury or death to site workers and the general public.

There are no effects to human health and socio-economic conditions anticipated to be caused by the processing of ore and the management of tailings from the Beaver Dam Mine Project.

8.5.11.1.3 Effects of Other Projects in the Area

The existing haul road is used by lumber trucks, but the level of traffic varies seasonally and annually depending on which areas are undergoing timber harvesting. This traffic contributes to the overall risk of road accidents along the haul road.

8.5.11.1.4 Cumulative Effects on the Human Health and Socio-Economic Conditions

All traffic on the haul road and any crossroads contribute to the risk of road accidents with the project area. The largest contributor to this traffic during the life of the project will be the trucking of ore from the Beaver Dam mine site to the Touquoy processing facility. Because the other sources of road traffic are much smaller, the cumulative effects are essentially the same as those of the proposed project. In the absence of the Beaver Dam Project, the cumulative effects would therefore be smaller. The principal assumption behind this assessment is that local road usage will not change in any important way during the life of the Beaver Dam Project. This assumption is considered as having a low uncertainty.

8.5.11.2 Mitigation

The mitigation measures proposed with regards to Human Health and Socio-economic Considerations are presented in section 6.13.7. Since the cumulative effects are driven primarily by the Project effects, with little contribution from other sources, no additional mitigation measures are warranted.

8.5.11.3 Residual Cumulative Effects and Significance Assessment

As indicated for the Project effects, there are no significant adverse cumulative environmental effects anticipated on health and socio-economics, once mitigation measures are applied.

8.5.11.4 Follow up and Monitoring Programs

No additional follow up or monitoring beyond that proposed for the Project in section 6.13.7 is proposed.

8.6 Cumulative Effects Summary

A cumulative effects assessment was carried out in order to meet the general requirements of the CEAA 2012, as well as the specific requirements laid out in the *Guidelines for the Preparation of an Environmental Impact Statement pursuant to the Canadian Environmental Assessment Act, 2012* and *Nova Scotia Registration Document pursuant to the Nova Scotia Environment Act – Beaver Dam Mine – Atlantic Gold Corporation*.

The VCs included in the Cumulative Effects Assessment into consideration were the following:

- Physical Environment
  - Atmospheric Environment
  - Surface Water Quality and Quantity.
  - Groundwater Quality and Quantity
- Biophysical Environment
  - Wetlands
  - Fish and Fish Habitat
  - Habitat and Flora
  - Terrestrial Fauna
  - Birds
  - Species of Conservation Interest and Species at Risk
- Socio-Economic Environment
  - Indigenous Peoples
  - Human Health and Socio-Economic Conditions

Major industrial projects that have or are taking place within a 35 km radius of the PA were identified. The following projects were considered as having cumulative effects on at least one VC:

- Past mining activities
- Regional Forestry Operations (Current, Past and Future)
- Touquoy Gold Project
- Cook’s Brook Sand and Gravel Pit

- ScoZinc Ltd.
- National Gypsum
- Murchyville Gypsum Quarry
- Tangier Gold Mine
- Dufferin Gold Mine
- Taylor Lumber Co. Ltd.
- Great Northern Timber
- Gaetz Brook Wind Farm
- New mining operations (hypothetical)

The main conclusions of the cumulative effects assessments are as follows:

- The proposed project contributes very little to the overall cumulative effects of regional industry to GHG emissions.
- The cumulative effects to surface water quality and to fish and fish habitat, including priority fish species are not expected to be significant, particularly considering that the proponent has committed to identifying culverts along the haul road that are currently in disrepair and removing/upgrading them where required. These cumulative effects also apply to the use of the surface water bodies and the fish inhabiting them by the Mi'kmaq of Nova Scotia.
- The total cumulative impacts on wetlands following the construction of the Beaver Dam Project are therefore a direct loss of 384,093 m^2 of wetlands and some signs of disturbance in wetlands covering an additional 107,825 m^2. The vast majority of this loss (83 %) comes from the losses connected to the Beaver Mine footprint.
- Overall, the generalized disturbance of the landscape by forestry activities, past, present and future are the main source of cumulative effects of habitats, flora, terrestrial fauna and birds throughout the area. These cumulative effects also lead to effects on current use of land and resources for traditional purposes by indigenous peoples and to effects to priority species (SOCI and SAR). As the Beaver Dam Mine site only contributes to a minority portion of the overall mining activities footprint, and because these effects are considered small compared to the generalized disturbance of the landscape by forestry activities, the cumulative effects with and without the project would be very similar at the regional level.
- All traffic on the haul road and any crossroads contribute to the risk of road accidents with the project area. This leads to effects to terrestrial fauna and health of both Indigenous and non-indigenous peoples. The largest contributor to this traffic during the life of the project will be the trucking of ore from the Beaver Dam mine site to the Touquoy processing facility.

Once the mitigation measures are taken into account, there are no significant residual cumulative effects anticipated for the atmospheric environment, surface water, groundwater, wetlands, fish and fish habitat, health and socio-economics.

Historical and current land use within the region has undeniably affected the local habitats in ways that have affected the local distribution and abundance of several species of flora terrestrial fauna and birds, including SOCI and SAR. However, the mitigation of the effects originating from regional forestry and land management practices falls outside the scope of the project proponent's authority and responsibility.

The predicted residual cumulative effects on Indigenous Peoples with regards to indirect effects from impacts to water quality, wetland habitats, and road safety, are assessed to be adverse, but not significant. The significant residual effects of historical and current land use within the region to the local distribution and abundance of several species of flora and fauna has presumably affected there use for traditional purposes.

9. Summary of Compliance and Effects Monitoring Programs

9.1 Environmental Follow-Up Program

Atlantic Gold understands that monitoring is a mechanism to gauge Project performance and measure against baseline conditions and effects as predicted in the EA, as well as expectations of regulators, the public, the Mi’kmaq of Nova Scotia and interested parties. Results of programs will be documented and where appropriate, summaries of compliance and effects monitoring programs will be available via stakeholder and Mi’kmaq engagement mechanisms, such as CLC. The CLC provides a mechanism to disseminate follow-up results and to share data.

The CLC is one of the primary opportunities for Atlantic Gold to include the participation of the local community, including First Nations communities, during development and implementation of the MRC Project. Beyond the CLC, Atlantic Gold will engage with local community groups and the Mi’kmaq of Nova Scotia, as well as information with the pubic. Atlantic Gold recognizes the inherent value in an open and flexible approach to engagement and monitoring. The Proponent views engagement and monitoring programs as dynamic and not static, such as collection of data, review of data, and refinement of programs, as well as mechanisms to share the results of programs. Atlantic Gold’s approach to engagement is presented in Section 3 and 4 of the EIS.

Prior to the start of construction activities, monitoring programs for select VCs will be undertaken. These monitoring programs will be undertaken to further design the mitigation measures that will be required during the construction phase of the Project, as well as defining sampling program components, locations, frequency, and parameters related to the MMER program and related to the other permitting, such as those required for wetland and watercourse alterations.

The VCs that will be included in the environmental follow-up program include sediment, surface water, groundwater, wetlands, fish and fish habitat, habitat and flora, birds, SAR and SOCI (fish and fish habitat, habitat and flora, terrestrial fauna, and birds), and Indigenous Peoples. The follow-up monitoring programs may be implemented up to one year prior to the start of construction; however, details of these programs will be determined following discussions with regulators. Pre-construction monitoring will be completed based on seasonality as required (e.g., breeding seasons, winter track surveys, vegetation surveys, etc.).

The results of the follow-up monitoring programs will be provided to regulators as per the conditions of the EA and other approvals and permits. The CLC and other interested stakeholders will be informed of the results of the follow-up programs and will be involved in the planning and implementation of these programs, where deemed appropriate.

In the event that an unexpected deterioration of the environment is observed, the results will be discussed with regulators and mitigation programs and operational practices will be reviewed to determine the appropriate course of action.

Table 9-1 Summary of Environmental Follow-Up Program

Valued Component Affected	Pre-Construction Monitoring Program
Atmospheric Environment	• Complete baseline ambient air quality monitoring at select baseline sampling locations prior to the start of construction • Complete baseline noise monitoring at select locations on the mine site and along the haul road prior to the start of construction
Geology, Soils, and Sediment	The MMER program would involve more detailed sediment sampling to determine final EEM program components, locations, frequency and parameters to be sampled. This would include parameters included in the baseline program and potential additions based on regulator input.
Surface Water Quality and Quantity	The MMER program would involve more detailed surface water sampling as well as site effluent sampling to determine final EEM program components, locations, frequency and parameters to be sampled for as well as possible species involved in the EEM. The existing network of surface water monitoring locations will be evaluated and used for site monitoring. Additional surface water monitoring locations will be added as required. A monthly sampling frequency is anticipated.
Groundwater Quality and Quantity	Installation of far network of multi-depth (shallow till and shallow bedrock) monitor wells (6-8 anticipated to be proposed) outside disturbed footprint that will be installed and monitored for no less than one year prior to the beginning of the construction phase. Water level and chemistry monitoring program to be proposed (anticipated for water levels to be collected monthly and chemistry samples to be collected quarterly throughout construction and operations). Groundwater monitoring at the Touquoy facility will continue prior to the beginning of processing of Beaver Dam ore. The program at Touquoy has been ongoing since 2016.

Table 9-1 Summary of Environmental Follow-Up Program

Valued Component Affected	Pre-Construction Monitoring Program
Wetlands	• Baseline hydrological conditions prior to construction activities; • Baseline vegetative conditions will be evaluated and compared with post construction conditions; • A final wetland monitoring plan will be developed prior to construction in conjunction with wetland alteration permitting.
Fish and Fish Habitat	Complete baseline monitoring measurements and observations prior to surface water alteration activities taking place.
Habitat and Flora	Complete baseline monitoring measurements and observations prior to wetland alteration activities taking place so that comparisons with post alteration conditions can be ascertained.
Terrestrial Fauna	N/A
Birds	Conduct a pre-construction survey of known raptor nests in the PA during breeding season
SAR and SOCI	• SAR and SOCI pre-construction monitoring programs will include the standard pre-construction monitoring programs proposed for Fish and Fish Habitat, Habitat and Flora, and Birds. • Additionally, a Moose Management and Monitoring Program should be implemented during pre-construction, through operation of the Project. The Moose Monitoring plan should include activities such as repeated winter track surveys and pellet group inventories, and collaborating with the Mi’kmaq of Nova Scotia to study Mainland Moose in a broader context
Indigenous Peoples	• Review of Mi’kmaq engagement strategy with the Mi’kmaq to be flexible as part of Project development • Review of Mi’kmaq input on specific actions and implementation where agreed with the Mi’kmaq CLC members

Table 9-1 Summary of Environmental Follow-Up Program

Valued Component Affected	Pre-Construction Monitoring Program
	• Complete and review approaches to specific engagement of nearby residents as mutually agreed with the Chief and Council and the staff of Millbrook First Nation • Monitoring of any future benefit agreement(s) as defined in the specific agreement, e.g., quarterly meetings of the implementation committee
Physical and Cultural Heritage Resources	N/A
Human Health and Socio-Economic Considerations	N/A

9.2 Environmental Monitoring Plans

Atlantic Gold recognizes that, as the Proponent, responsibility for all monitoring programs and mitigation commitments ultimately rest with Atlantic Gold. Many aspects of monitoring and mitigation that will occur during all phases of the Project (earthworks, construction, well installation, etc.) could be conducted through a sub-contract but Atlantic Gold ultimately has responsibility for implementing mitigation and monitoring strategies committed to in the EIS and for items added by regulators.

Atlantic Gold also recognizes that there may be additional requirements identified in approvals, such as the Industrial Approval that would be applied for from the Province of Nova Scotia through Part V – Approvals. Therefore, actual consultants or contractors have not been specified in the EIS but it is recognized that all will need to be qualified according to applicable regulatory requirements and ultimately are completing work for Atlantic Gold. Atlantic Gold has ongoing operations in Nova Scotia and is familiar with the characteristics of monitoring programs in terms of location, planned protocols, listed parameters, analytical methods, schedule, and the human and financial resources required. Beaver Dam is within close proximity to staff and resources such as monitoring equipment so that experienced staff of Atlantic Gold and/or its contractors will be involved in the monitoring programs.

Monitoring reports will be completed at a frequency determined by NSE. This is anticipated to be annual based on the existing IA for the Touquoy Gold Project. The regulatory agencies will provide guidelines for preparing monitoring reports, such as the number, content, frequency, and format.

In the event that non-compliance with regulatory requirements is observed, operational practices and compliance programs will be reviewed to determine the appropriate course of action.

The table below identifies aspects of the Project that have shown to require an appropriate plan for monitoring. The table also provides detail on the monitoring and planned activities to gather data to determine any additional mitigation measures to protect the environment.

Table 9.2 Summary of Monitoring Programs

Valued Component	Monitoring Program
Atmospheric Environment	
Air Quality	• Air quality monitoring including dust and ambient-air monitoring, as required at select baseline sampling locations as as per the Proponent's EPP and directed by regulators. Typical frequencies for this monitoring would be expected to follow NAPS and possible variations as outlined in the EA or subsequent approvals. • Additional TSP monitoring would be required to measure the full effects on suspended particulate matter once mine operations begin. An audit program of the same sampling sites originally chosen for the baseline monitoring will be implemented. Additional sites may be required beyond those used in baseline with sampling at a frequency of no less than annually. • A daily inspection of pit slopes by qualified personnel and an independent consultant to review slopes on a quarterly basis. • Air quality monitoring at the Touquoy mine site will continue as per monitoring put in place throughout the operation of the Touquoy mine (as required by the IA) , including TSP sampling at six monitoring locations during dry periods and maintaining compliance for stack emission limits.
Greenhouse Gas Emissions	Review of emissions on an annual basis and seek to use BAPs that evolve over time.
Noise	• Noise monitoring program will be undertaken, including blasting noise monitoring and periodic noise level monitoring at the property boundaries. Additional monitoring may be required as directed by regulators with typical frequency being on an annual basis to confirm baseline or a spot basis if complaints or issues are raised by the public or regulators. • Noise monitoring would be completed at nearest residence for each blasting event, as required by the conditions of any approval and as is typically the practice in Nova Scotia. • Noise monitors may be attached to workers form time to time to measure and monitor noise exposure over a shift • Noise monitoring at the Touquoy mine site will continue as per monitoring put in place throughout the operation of the Touquoy mine (as requested by NSE per IA requirements).
Night-time Light Levels	Review of practices relative to mine site and haul road operation on an annual basis for BAPs including illumination.
Geology, Soils, and Sediment	

Valued Component	Monitoring Program
Soil	N/A – soils are being re-used at site no net loss and no need for monitoring.
Sediment Quality	• Annual sampling at select baseline sediment locations (Sed. 1, 2, 3, 6 and 7) for metals suite completed for baseline. • The MMER program would involve more detailed sediment sampling to determine final EEM program components, locations, frequency and parameters to be sampled for. This would include parameters included in the baseline program and potential additions based on regulator input.
Bedrock	• During construction and operations, regular testing of rock will be conducted for acid generating potential at a rate to be determined by NSE, anticipated to be no less than 1 sample per 100,000 tonnes of rock generated.
Surface Water Quality and Quantity	
Surface Water Quality	• The MMER program would involve more detailed surface water sampling as well as site effluent sampling to determine final EEM program components, locations, frequency and parameters to be sampled for as well as possible species involved in the EEM. • Surface water quality monitoring at select baseline sampling locations on the mine site and the haul road to compare data to applicable guidelines and baseline data. This is anticipated to be conducted monthly for general chemistry and metals throughout the construction, operations, and decommissioning phases. • Annual review of program and need for revisions based on baseline data comparison and discussions with regulators. • Monitored discharge guided by a Surface Water Monitoring Plan • Inspection and Monitoring Plan that includes hydrologic flow analysis • Weekly inspections of diesel fuel supply and barriers • Surface water, groundwater, and wetlands monitoring data to be reviewed annually for potential interactions and revisions to program(s) if warranted. • Ongoing monitoring will continue at the Touquoy facility, as per regulatory requirements, which began in 2016. This includes monitoring of 16 surface water monitoring stations and monitoring of two permanent gauges in Moose River. This program will be reviewed by regulators and any appropriate changes to the monitoring program due to the processing of Beaver Dam ore will be implemented. • Ongoing monitoring related to the EEM at the Touquoy facility.

Valued Component	Monitoring Program
Groundwater Quality	
Groundwater Quality	Construction: • Monitoring of the pre-construction monitoring wells will continue throughout the construction and operations phases at these monitoring wells. This will include the far network of multi-depth (shallow till and shallow bedrock) monitor wells (6-8 anticipated to be proposed) outside disturbed footprint that will be installed prior to the beginning of the construction phase. Water level and chemistry monitoring program to be proposed (anticipated for water levels to be collected monthly and chemistry samples to be collected quarterly throughout construction and operations). • Annual review of program and need for revisions based on baseline data comparison and discussions with regulators. Operation: • Installation of near network multi-depth (shallow till and shallow bedrock) monitor wells (6-8 anticipated to be proposed) close to and within disturbed footprint at the beginning of operations. Water level and chemistry monitoring program to be proposed (anticipated for water levels to be collected monthly and chemistry samples to be collected quarterly throughout operations). • Ongoing monitoring will continue at the Touquoy facility, as per regulatory requirements, which began in 2016. This includes monitoring of 32 pairs of nested groundwater monitoring stations across the Touquoy site, and regular monitoring of data loggers installed in seven monitoring wells around the open pit mine. This program will be reviewed by regulators and any appropriate changes to the monitoring program due to the processing of Beaver Dam ore will be implemented. • Annual review of program and need for revisions based on baseline data comparison and discussions with regulators. Decommissioning: • Select far and near network wells to be proposed for this phase based on results of mine life monitoring program. 6-8 anticipated to be proposed for water level and chemistry monitoring at the same frequency and parameters as the operations phase until such time that the data suggests that a reduction in monitoring frequency can occur.

Valued Component	Monitoring Program
	• The frequency and location of groundwater monitoring will be described in greater detail in the EPP following consultation with regulatory agencies and will be outlined in the IA application. • Annual review of program and need for revisions based on baseline data comparison and discussions with regulators. • Surface water, groundwater, and wetlands monitoring data will be reviewed annually for potential interactions and revisions to program(s) if warranted.
Wetlands	
Wetland Habitat	• Baseline hydrological conditions prior to construction activities; • Baseline vegetative conditions will be evaluated and compared with post construction conditions; • In combination with other monitoring requirements associated with the Project, water quality will be monitored in down-gradient aquatics receptors to ensure that up-gradient activities are not compromising water quality conditions; and • General observations will be completed during the construction phase and post construction phase. • A final wetland monitoring plan will be developed prior to construction in conjunction with wetland alteration permitting. • Surface water, groundwater, and wetlands monitoring data to be reviewed annually for potential interactions and revisions to program(s) if warranted.
Fish and Fish Habitat	
Fish Habitat	• Complete baseline monitoring measurements and observations prior to surface water alteration activities taking place. • Regular monitoring during the construction phase to ensure protective measures are being implemented at schedule and location as directed by regulators and as per Proponent's EPP. Monitoring is anticipated to be daily for construction near sensitive areas or following a rain event, and weekly for operations and as appropriate for reclamation and post-reclamation periods; • Regular monitoring of fish habitat in wetlands and watercourses to evaluate their condition and integrity post decommissioning phase. This will ensure

Valued Component	Monitoring Program
	impacts have not occurred as a result of decommissioning activities (i.e., water management structure removal). • A fish and fish habitat monitoring program will be developed in collaboration with DFO in association with requirements of wetland and watercourse alteration permits issued for direct wetland and watercourse alterations associated with the Project. Monitoring of surface water will also be completed which will support monitoring for potential impacts to fish and fish habitat. The frequency and location of fish and fish habitat monitoring will be described in greater detail in the EEM following consultation with regulatory agencies. • Continued monitoring of surface water at the Touquoy site as required by the IA, which will provide data to evaluate any potential impacts to fish and fish habitat.
Habitat and Flora	
Habitat and Flora	• Complete baseline monitoring measurements and observations prior to wetland alteration activities taking place so that comparisons with post alteration conditions can be ascertained; • Complete construction monitoring to ensure protective measures are being implemented, and review of construction after completion. Additional mitigation and monitoring measures will be determined at that time. It is anticipated that daily monitoring during construction, weekly monitoring during the operations and reclamation periods, and monthly monitoring post-reclamation will be completed; and • Monitoring of remedial activities to evaluate their success in establishing habitat for wild species, and monitoring wetlands for condition and integrity may be necessary post decommissioning phase.
Terrestrial Fauna	
Terrestrial Fauna Habitat	• Complete regular construction observations to ensure protective measures are being implemented; and • Monitoring of remedial activities to evaluate their success in establishing habitat for wild species, and monitoring wetlands for condition and integrity may be necessary post decommissioning phase.

Valued Component	Monitoring Program
Birds	
Bird Habitat	• Conduct a pre-construction survey of known raptor nests in the PA during breeding season • A follow-up monitoring program is recommended from the start of construction to the end of decommissioning. • Verify the effectiveness of mitigation measures related to light based on advice from appropriate jurisdictions, and implement adaptive measures if required. • Monitor known nests around stockpiles and exposed areas from a distance with a spotting scope or binoculars to verify the effectiveness of the buffer until the nests are inactive; • Conduct routine inspections, as directed by regulators but anticipating daily observations by operators, monthly inspections by qualified avian experts during construction, operation and pit re-filling of the open pit area to remove any trapped or injured birds; and • Notify Environment and Climate Change Canada within 24 hours in the event of the mortality or injury of ten or more migratory birds in a single event or in the event of the mortality or injury of a migratory bird species at risk.
SAR and SOCI	
Priority Fish Species	• Standard monitoring for fish and fish habitat is expected to appropriately mitigate effects on priority fish species. • A monitoring program will be developed to measure post construction water quality and quantity in the Killag River, where the potential effect of the Project on surface water and priority fish species is the highest. • Monitoring will likely occur at the baseline sampling location on the West River Sheet Harbour and additional locations if directed by regulators.
Priority Vascular Flora and Lichens	SAR and SOCI monitoring programs will include the standard monitoring programs proposed for habitat and flora.
Priority Terrestrial Fauna	• SAR and SOCI monitoring programs will include the standard monitoring programs proposed for terrestrial fauna. • A Moose Management and Monitoring Program will be implemented during pre-construction and will continue through operation of the Project. The Moose

Valued Component	Monitoring Program
	Monitoring plan should include activities such as repeated winter track surveys and pellet group inventories, and collaboration with the Mi'kmaq of Nova Scotia to study Mainland Moose in a broader context • Wildlife observation reporting to appropriate site personnel during construction, operation and decommissioning of Project
Priority Birds	• SAR and SOCI monitoring programs will include the standard monitoring programs proposed for birds. • Verify the effectiveness of mitigation measures related to light for a minimum of two years and, based on advice from appropriate jurisdictions, implement adaptive measures, if appropriate • Monitor known nests around stockpiles and exposed areas from a distance with a spotting scope or binoculars to verify the effectiveness of the buffer until the nests are inactive
Indigenous Peoples	
Indigenous Peoples	• As part of the EMS and associated procedures under the EPP, the Proponent will ensure mitigation measures are undertaken to prevent irreversible damage to Mi'kmaq archaeological resources and burial sites, including ensuring activities are within the defined Project area • Review of Mi'kmaq engagement strategy with the Mi'kmaq to be flexible as part of Project development • Review of Mi'kmaq input on specific actions and implementation where agreed with the Mi'kmaq CLC members • Complete and review approaches to specific engagement of nearby residents as mutually agreed with the Chief and Council and the staff of Millbrook First Nation • Monitoring of any future benefit agreement(s) as defined in the specific agreement, e.g., quarterly meetings of the implementation committee • Completion of monitoring programs associated with other VCs outlined above to avoid indirect effects on the Mi'kmaq of Nova Scotia
Physical and Cultural Heritage	
Physical and Cultural Heritage Resources	Ensure mitigation measures are undertaken to prevent damage to identified features.
Human Health and Socio-Economics	
Recreational Activities	N/A
Traffic	N/A

10. Environmental Impact Statement Summary and Conclusions

10.1 Summary of the Environmental Impact Statement

As described throughout the EIS, Project-environment interactions are expected to occur throughout the life of the Project during the construction, operations, and decommissioning phases. These interactions are expected and are typical of environmental impacts associated with quarry and mineral extraction projects in the region.

Given the considerations identified above, and based on significant baseline studies completed for each of the identified VCs, the Project is not likely to result in any significant adverse environmental effects after mitigation measures have been applied. Monitoring programs will proceed to gather pre-construction data for select VCs. This data will be used to refine mitigation measures and monitoring programs for the construction, operation, and reclamation phases. Monitoring programs will continue throughout the life of the Project to verify baseline conditions and to determine the effects of the Project on the surrounding environment. A summary of the potential adverse residual effects associated with the Project, and their associated significance, is summarized in Table 10-1. Key mitigation measures that will specifically mitigate the potential adverse residual effects are summarized in Table 10-2. Proposed mitigation measures are described in greater detail in the effects assessment for each individual VC in Section 6.

Atlantic Gold recognizes that, as the Proponent, responsibility for all mitigation commitments ultimately rest with Atlantic Gold. Many aspects of mitigation that will occur during all phases of the Project (earthworks, construction, well installation, etc.) could be conducted through a sub-contract but Atlantic Gold ultimately has responsibility for implementing mitigation strategies committed to in the EIS and for items added by regulators.

Table 10-1 Summary of Environmental Impact Statement

Valued Component Affected	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
				Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
Atmospheric Environment											
Air Quality	-	Dust emissions generated during the construction phase of the Project due to clearing and construction and commissioning of support infrastructure, and during the life of the Project due to heavy machinery operation and vehicle activity.	Minimize dust through: • Wet suppression controls on unpaved surfaces • Maintaining hardened surfaces where practical • Speed reduction on the mine site to keep dust levels to a minimum • Air quality monitoring including dust and ambient-air monitoring, as required at select baseline sampling locations. • Design of slopes to reduce slope failure; • Construction of a berm surrounding the surface mine, minimizing unstable slopes due to water infiltration; •	L	PA	ST/ MT	R	R/ IR	LD	Disturbance	Not Significant
	-	Dust emissions generated during construction of the haul road and due to haul truck activity during the life of the Project		M	PA	ST/ MT	R	IR	MD	Disturbance	Not Significant
	-	Dust emissions generated through the life of the Project,		M	PA	MT	R	IR /R	LD	Disturbance	Not Significant

Valued Component Affected	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
				Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
		including blasting and drilling, haul truck activity, and crushing of ore	• Stabilized slopes will be maintained on the waste rock stockpile following completion of operations								
		Dust emissions generated through the life of the Project from the waste rock, till, and ore stockpiles	• The crushed ore stockpile at Touquoy will be covered to minimize wind and rain erosion • Haul trucks will be covered to minimize dust during transportation between the mine site and the Touquoy facility	L	PA	LT	R	R	LD	Disturbance	Not Significant
Greenhouse Gas Emissions	-	Greenhouse Gas Emissions generated during the construction, operations, and decommissioning phases	Minimize GHG emissions: • Limited engine idling where possible • Implementing fuel efficiencies where possible • Regular maintenance on equipment	M	PA	MT	R	IR	MD	Disturbance	Not Significant
Noise	-	Noise generated during the construction and operations phases of the Project	Minimize noise through: • Regular maintenance of equipment • Highway truck traffic will not generally be present on	M	PA	MT	R	IR	MD	Disturbance	Not Significant

Valued Component Affected	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
				Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
			the haul road during night-time hours.								
Night-time Light Levels	-	Night-time light levels generated on the mine site and the haul road during the construction and operations phases	Minimize light pollution through: • Install downward-facing lights on site infrastructure and haul roads. • Wherever possible, install motion-sensing lights to ensure lights are not turned on when they are not necessary. • Only use direct and focused light when needed for worker safety. • Maintain haul road operation to 12-16 hours per day (i.e. highway truck traffic will not generally be present on the haul road during night-time hours.)	L	PA	MT	R	R	MD	Attraction and Disorientation (birds) None (other)	Not Significant
Geology, Soil, and Sediment Quality											
Sediment Quality	-	Effects on sediment quality due to erosion, or effects on sediment quality downstream of the PA due to activities	• Sediment and erosion control measures; • Design of settling ponds and outflow structures to minimize out flow velocities.	M	LAA	MT	S	R	MD	Sediment quality impacted by Project beyond natural	Not Significant

Valued Component Affected	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
				Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
		occurring on the mine site and haul road.								fluctuations that affects aquatic habitats and or species negatively.	
Surface Water Quality and Quantity											
Surface Water Quality	-	Changes to surface water quality as a result of Project activities, including construction, operations, and decommissioning.	• Sedimentation ponds will be utilized to treat water (TSP) from surface runoff and pit water. Treated water will be allowed to discharge to the environment; • All surface water discharges from sedimentation ponds to the natural environment will be sampled as per requirements listed in industrial operating approvals and MMER to ensure water quality conforms to applicable guidelines; • Stockpiles will employ perimeter ditches to direct water to ponds.	MP	PA/LAA	LT/MT	R/O	R/IR	MD/LD	Disturbance Habitat loss	Not Significant
		Changes to surface water quality as a result of construction and operations, including heavy machinery operations		M	PA	ST	R	R	LD	Disturbance	Not Significant
		Changes to surface water quality and hydrology due to the construction and		L	PA	P	O	IR	LD	Habitat Loss Disturbance	Not Significant

Valued Component Affected	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
				Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
		upgrades associated with the haul road	Topographic controls will ensure that overflow from extreme weather conditions, should it occur, will be directed to the pit to be treated later; • Development of an Erosion and Sediment Control Plan; • Development of a Stormwater Management Plan • Diesel fuel will be stored in double-walled, aboveground storage tanks with perimeter impact protection located on a concrete pad; • Emergency Spill Response Training, with annual updates required • Development of an Emergency Response and Spill Contingency Plan; and • Wetland Compensation Plan that describes an inspection and monitoring								

Valued Component Affected	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
				Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
			program for site and adjacent wetlands will be developed in collaboration with NSE. • Sediment and erosion control • Spill preparedness and best management practices								
	-	Changes to surface water quality as a result of blasting and drilling of in-situ rock	• Pre-blasting plan and evaluation of potential to indirectly impact surface water habitat.	L	PA	ST	R	R	LD	Disturbance	Not Significant
Surface Water Quality	-	Effects on surface water quality in the Touquoy PA due to the storage of tailings in the exhausted pit at the Touquoy facility	• Best management practices • Continuation of the monitoring program that is currently underway at Touquoy (since 2016).	L	PA	P	R	IR	MD	Disturbance	Not Significant
Surface Water Quantity	-	Direct surface waterbody alteration due to infilling, draining, flooding, altering function, and altering groundwater recharge capacity on	• Wetland Compensation Plan that describes an inspection and monitoring program for site and adjacent wetlands will be developed in collaboration with NSE.	M	PA	P	O	IR	LD	Habitat Loss Disturbance	Not Significant

Valued Component Affected	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
				Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
		the mine site and the haul road	• Surface water monitoring and compensation								
	-	Indirect surface waterbody alteration	• Surface water monitoring and compensation	L	LA A	M	S	R	LD	Disturbance	Not Significant
Groundwater Quality and Quantity											
Groundwater Quality	-	Effects on groundwater quality due to sediment and erosion, and reduced infiltration due to disturbance during construction and operations	• Sediment and erosion control • Installation of multi-depth monitoring wells. Water level and chemistry monitoring program to be implemented • Spill preparedness and best management practices	M	PA	LT /S T	R	R	MD /LD	Disturbance	Not Significant
Groundwater Quality	-	Effects on groundwater quality in the Touquoy PA due to the storage of tailings in the expended pit at the Touquoy facility	• Best management practices • Continuation of the monitoring program that is currently underway at Touquoy (since 2016).	L	PA	P	R	IR	MD	Disturbance	Not Significant
Groundwater Quality	-	Hydrological and groundwater quality changes due to the	Engage watercourse alteration permitting process	L	PA	P	O	IR	LD	Disturbance	Not Significant

Valued Component Affected	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
				Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
		upgrades and new construction of the haul road	Surface water monitoring								
Groundwater Quality		Effects on water quality of potable wells at Beaver Lake IR 17	N/A	-	-	-	-	-	-	None	N/A
Groundwater Recharge / Discharge	-	Hydrological effects on recharge/discharge due to construction, water body alteration and dewatering, and operations.	Project design includes use of pit dewatering water and collected surface water instead of groundwater for dust control. No other on-site water use except for small domestic purposes (office building less than 10 Lpm) expected.	L/ M	PA	P/ M T	O / S	R/ IR	LD	Disturbance	Not Significant
Wetlands											
Wetland Habitat	-	Progressive loss of wetland habitat due to construction and operation of the mine site and haul road, including blasting	• Wetland awareness with construction staff and personnel; • Sediment and erosion control; • Vegetation management in or near wetlands (i.e. to limit clearing, clearing by cutting, no herbicides, etc.);	L/ M	PA	ST /L T	R	R	LD	Disturbance Habitat Loss	Not Significant

Valued Component Affected	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
				Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
			• Wetland avoidance and permitting, including engaging in the wetland alteration application process; • Limit driving and use of machinery in wetland habitat, where reasonable; • Reclamation during decommissioning, including maintenance or removal of water management structures as required, and implementation of erosion measures; • Spill control and emergency planning; • Wetland monitoring and compensation; and • Pre-blasting plan and evaluation of potential to indirectly impact wetland habitat.								
Wetland Hydrology	-	Hydrological changes due to direct and indirect	Maintenance of pre-construction hydrological flows into and out of down-stream	L/ M	PA	P/ M T	O / S	R/ IR	LD	Disturbance Habitat Loss	Not Significant

Valued Component Affected	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
				Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
		wetland alteration, haul road construction	wetland habitats and partially altered wetlands, to the extent possible (post alteration wetland monitoring maybe required as a result of provincial permitting process)								
Fish and Fish Habitat											
Fish Habitat	☑ 5(1)(a)(i)	Fish habitat loss/alteration due to construction activities	• Sediment and erosion control; • Vegetation management in or near wetlands (i.e. to limit clearing, clearing by cutting, etc.); • Engage wetland and watercourse permitting processes. Loss of fish habitat will be addressed in these alteration applications; • Fish habitat awareness and avoidance where possible; • Fish habitat restoration activities; • Maintenance of pre-construction hydrological flows into and out of down-stream surface water	L	PA	LT	R	R	LD	Habitat Loss Disturbance	Not Significant
		Direct fish habitat alteration due to alterations to wetlands		M	PA	P	O	IR	LD	Habitat Loss	Not Significant
		Indirect fish habitat alteration		L	PA	M	S	R	LD	Disturbance	Not Significant
		Disturbance to fish habitat due to construction and operation of the mine site including increased sediment, impacts to water quality from dust,		L/ M	PA	ST	R	R	LD	Habitat Loss Disturbance	Not Significant

Valued Component Affected	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
				Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
		introduction of invasives, and wetland alteration	habitats to the extent possible; • Recommended timing windows will be adhered to for potential direct loss of fish and fish habitat (to limit loss of eggs and juveniles), as directed by DFO; • Reclamation during decommissioning; • Limit driving and use of machinery within wetland and watercourse habitat where practical; • Spill control and planning; and • Pre-blasting plan, including setback recommendations and evaluation of potential to indirectly impact wetland habitat.								
		Disturbance to fish habitat due to construction and operation of the haul road		L	PA	P	O	IR	LD	Habitat Loss	Not Significant
Habitat and Flora											
Habitat and Flora	-	Habitat loss or damage due to construction of the mine site and haul	Intact forest stands and wetlands will be avoided wherever possible in favor	H	PA	LT	O	R	MD	Habitat Loss Disturbance	Not Significant

Valued Component Affected	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
				Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
		road, including increased sediment, clearing and grubbing, wetland alteration, and upgrading the haul road	of previously disturbed areas; Where natural, intact habitat cannot be avoided, minimization of total Project footprint will be considered; Erosion and sediment control planning; Monitoring dust conditions and when normal precipitation levels are not enough to suppress fugitive dust, water trucks can be used to suppress dust; Winter road maintenance will include conventional snow clearing and deposition of sand for traction control where necessary. Road salt will not be used; Haul trucks will be equipped with spill kits and instructed on their use and spill								
		Habitat loss or damage due to operations on the mine site and haul road, including the operation of heavy machinery and vehicles, and haul truck activity		L	PA	M T	R	R	LD	Disturbance	Not Significant

Valued Component Affected	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
				Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
			prevention and appropriate site personnel will be trained in spill isolation, containment, and recovery; A wetland alteration application will be submitted to request an authorization to alter wetland habitat. Loss of function will be addressed in this wetland alteration application; and, Compensation for permanent loss of wetland function will be completed through wetland restoration activities to support no net loss of wetland function, subject to NSE approval.								
Terrestrial Fauna											
Terrestrial Fauna Habitat	-	Disturbance of wildlife habitat due to construction of the mine site, including clearing and grubbing,	Intact forest stands and wetlands will be avoided wherever possible in favor of previously disturbed areas and/or minimization of	L	PA	MT	O	R	MD /LD	Habitat Loss Disturbance	Not Significant

Valued Component Affected	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
				Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
		construction of infrastructure	total Project footprint will be considered during planning;								
		Disturbance of wildlife habitat due to operations on the mine site, including heavy machinery operation, vehicle activity, open pit lighting, and blasting	Habitat fragmentation will be reduced by limiting the area of new roads, favoring upgrading of existing roads where possible instead; Site infrastructure will be fenced in, where practical,	L	PA	M T	R	IR /R	LD	Disturbance Direct mortality	Not Significant
		Disturbance of wildlife habitat due to the haul road construction and upgrades	to reduce interactions between Project infrastructure and wildlife; An unvegetated buffer along roadsides will be maintained, where possible; Clearing and construction will be limited within wetlands that could support snapping turtles during winter hibernation period; Culverts installed within wetlands and watercourses will provide an alternative crossing location to	M	PA	LT	O	R	MD	Habitat Loss	Not Significant

Valued Component Affected	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
				Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
			amphibians and reptiles, thereby reducing direct mortality of species attempting to cross a road; Watering of roads during dry conditions; Waste management to reduce attracting opportunistic wildlife species; Erosion and sediment control planning; A wetland alteration application will be submitted. Loss of function and habitat for species reliant on wetland habitat will be addressed in this wetland alteration application; Compensation for permanent loss of wetland function will be completed through wetland restoration								

Valued Component Affected	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
				Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
			activities to support no net loss of wetland function, subject to NSE approval; Water management; Spill control; Vegetation management (i.e., no use of herbicides); and Ensure all development related activity is located within areas where biophysical field evaluations have been completed and approvals/written authorizations are in place as required.								
Terrestrial Fauna Mortality	-	Increased truck traffic on the haul road and on the mine site	A speed limit of 50 km/hr within the mine footprint and 70km/hr along the Haul Road will be implemented to reduce likelihood of collisions with fauna; and Site infrastructure will be fenced in, where practical,	L/ M	PA	M T	R	R	LD/ MD	Disturbance Direct Mortality	Not Significant

Valued Component Affected	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
				Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
			to reduce interactions between Project infrastructure and wildlife								
Birds											
Bird Habitat	☑ 5(1)(a)(iii)	Disturbance of bird habitat due to construction of the mine site and haul road, including clearing and grubbing, construction of infrastructure, and construction of the haul road	Bird awareness and management, including avoiding construction during the breeding season for migratory birds where practical, discouraging ground-nesting or burrow-nesting species, and applying a buffer zone around any identified nests for specified species	M	PA	ST /MT	O	IR /R	HD /M D	Disturbance Habitat Loss	Not Significant
		Disturbance of bird habitat due to operations on the mine site and the haul road, including heavy machinery operation, vehicle activity, and open pit lighting	Reduce impact of light pollution on birds by minimizing on-site lighting while still allowing for safe operation, and by installing lighting which faces the ground; Maintain speed limits on mine roads (max. 50 km/hr	L/ M	PA	MT	R	R	MD	Disturbance Attraction and disorientatio n Mortality	Not Significant

Valued Component Affected	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
				Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
			within mine footprint, 70 km/hr along haul road). Reduce speed limit and install signage where specific wildlife concerns have been identified; Noise controlled by attenuation, vertical separation, and equipment design where practical; Dust control where there are increased dust emissions; Compensate for lost wetland functions that support migratory birds as part of the wetland compensation plan; and Notify Environment and Climate Change Canada within 24 hours in the event of the mortality or injury of ten or more migratory birds in a single event or in the event of the mortality or								

Valued Component Affected	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
				Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
			injury of a migratory bird species at risk.								
SOCI/SAR											
Priority Fish Species	☑ 5(1)(a)(ii)	Disturbance to fish habitat due to construction and operation of the mine site and haul road, including increased sediment, impacts to water quality from dust, introduction of invasives, and wetland alteration	• Standard mitigation for fish and fish habitat; • Work with organizations to form partnerships to allow for data sharing; • Communication of watercourse alteration terms and conditions for watercourses which support priority fish species; fish rescue will be completed prior to commencement of mine development; • All culverts will be installed in accordance with the NSE Watercourse Standard to ensure fish passage through new culverts, and by upgrading or removing							Habitat Loss Disturbance	Not Significant

Valued Component Affected	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
				Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
			improperly installed culverts, where possible; and, • The location of all watercourses known to support priority species will be communicated to site personnel along with recommended mitigation measures.								
Priority Vascular Flora and Lichens	☑ 5(1)(a)(ii)	Habitat loss or damage due to construction and operation of the mine site and haul road, including increased sediment, clearing and grubbing, and wetland alteration	• Standard mitigation measures for wetlands and habitat and flora; • SOCI awareness will be communicated to all personnel; • Priority species that are located within the direct footprint of the mine infrastructure or haul road, where deemed reasonable and appropriate, will be transplanted to nearby suitable habitat; and, • A lichen monitoring program for lichen SAR identified in							Habitat Loss Disturbance	Not Significant

Valued Component Affected	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
				Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
			close proximity to the Project Area will be established.								
Priority Terrestrial Fauna	☑ 5(1)(a)(ii)	Disturbance of wildlife habitat due to construction and operation of the mine site and haul road, including clearing and grubbing, heavy machinery operation, vehicle operation, construction of infrastructure and the haul road, open pit lighting, and blasting	• Standard mitigation for terrestrial fauna; • Implementing a 30m buffer on aquatic habitat deemed suitable for Snapping Turtles, wherever possible; • Culverts will be installed in wetlands and watercourses under provincial permits as required; • Wetland and watercourse alterations; • Implement signage on the haul road during operations adjacent to major stream crossings or waterbodies; and • Dust suppression.							Disturbance Direct Mortality	Not Significant
Priority Birds	☑ 5(1)(a)(ii)	Disturbance of bird habitat due to construction and operation of the mine site and haul road, including clearing	• Standard mitigation for birds; • Communicate regulations related to nesting birds to all site personnel. If nesting behavior of any bird is							Disturbance Habitat Loss Attraction and	Not Significant

Valued Component Affected	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
				Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
		and grubbing, heavy machinery operation, vehicle operation, construction of infrastructure and the haul road, open pit lighting, and blasting	observed, site personnel are to report this activity; and, • To limit attraction of Common Nighthawk (CONI) to the Project Area, the amount of exposed soil should be limited during nesting season, favoring to cover or revegetate soil wherever possible.							disorientatio n Mortality	
Indigenous Peoples											
Indigenous Peoples Physical and Cultural Heritage	☑ 5(1)(c)	Construction activities associated with mine site and haul road resulting in direct effect on archaeological resources or burial sites that are not in the Project area	• Ensure no Project activities occur outside of Project Area • Education and procedures in place as part of EPP to halt work and notify the Mi'kmaq if archeological deposits encountered.	L	PA	ST	O	IR	LD	None	Not Significant
Indigenous Peoples Traditional Uses of Land and Resources		Construction activities associated with mine site and haul road resulting in direct loss of plant specimens of	• Minimize footprint as per Project design. • Implementation of mitigation and monitoring of per other VCs to minimize indirect effects.	L	PA	ST	O	IR	LD	Loss of plant specimens Habitat Loss	Not significant

Valued Component Affected	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
				Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
		significance to the Mi'kmaq, and direct loss of habitat including wetlands	• Complete wetland compensation as per NS policy. • Engagement the Mi'kmaq in Project, including monitoring and compensation.								
Indigenous Peoples Socio-Economics		Employment and Economic benefits	Ongoing discussions to negotiate benefit agreement(s) with the Mi'kmaq of Nova Scotia.	L	LAA	MT	R	R	N/A	Benefits to the Mi'kmaq	Not significant
Physical and Cultural Heritage											
Physical and Cultural Heritage Resources	-	Damage to cultural/physical heritage resources during the construction phase	• Shovel testing shall be conducted around the possible cookhouse (Feature 5) or a buffer of 20 metres be put in place around the feature to protect it from any mining activities; • Intensified reconnaissance if development will occur within 100 metres of Crusher Lake; • If any development is to occur specifically around the historic features identified	L	PA	ST	O	IR	N/A	None	Not Significant

Valued Component Affected	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
				Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
			during the reconnaissance, intensified research and archaeological shovel testing should be conducted; • Any further changes in the layout of the mine and facilities be evaluated; and • In the event that archaeological deposits or human remains are encountered, the Coordinator of Special Places, Nova Scotia Communities, Culture, & Heritage Department must be contacted								
Human Health and Socio-economic Considerations											
Recreational Activities	-	Restriction of recreational activities within the PA during construction and operation of the mine site	• Restriction of recreational activities within the spatial boundaries of the Project. Notification will be provided by signage;	L	PA	MT	C	R	LD	Disturbance	Not Significant

Valued Component Affected	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
				Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Social Context		
			• Liaison with any local recreation groups, such as ATV associations.								
Employment	-	Direct and indirect employment opportunities throughout the construction, operation, and decommissioning phases of the Project	N/A	M	RAA	MT	R	R	MD	Creation of employment opportunities	Not Significant
Traffic	-	Increased traffic along the haul road, including the potential for a mobile equipment accident	• Equipment maintenance; • Limiting haul truck operational hours to 12 to 16 hours per day; and • Reduce risks of an accident through operator training, proper signage at intersections and along the haul road, and discussions with NSTIR	M	PA	MT	R	IR	MD	Disturbance	Not Significant

Table 10-2 Summary of Key Mitigation Measures and Commitments

Valued Component Affected	Residual Effect	Mitigation and Compensation Measures
Atmospheric Environment – Air Quality	Disturbance	Minimize dust through: • Wet suppression controls on unpaved surfaces • Maintaining hardened surfaces where practical • Speed reduction on the mine site to keep dust levels to a minimum • Air quality monitoring including dust and ambient-air monitoring, as required at select baseline sampling locations; • Design of slopes at an angle determined by geotechnical analysis and acceptable safety factors, to reduce the likelihood of a slope failure; • Construction of a berm surrounding the surface mine, and berms and channels surrounding stockpiles to direct surface water to water diversion channels, minimizing the risk of causing unstable slopes; • Stabilized slopes will be maintained on the waste rock stockpile following completion of operations; • The crushed ore stockpile at Touquoy will be covered to minimize wind and rain erosion • Haul trucks will be covered to minimize dust during transportation between the mine site and the Touquoy facility • Maintain the air emission source program in place at the Touquoy facility to monitor emissions for compliance.
Atmospheric Environment – GHG Emissions	Disturbance	Minimize GHG emissions: • Limited engine idling where possible • Implementing fuel efficiencies where possible • Regular maintenance on equipment
Atmospheric Environment – Noise	Disturbance	Minimize noise through: • Regular maintenance of equipment • Highway truck traffic will not generally be present on the haul road during night-time hours.

		• A noise monitoring program will be undertaken at the Beaver Dam mine site, including blasting noise monitoring and periodic noise level monitoring at the property boundaries as per IA conditions. • Complete noise monitoring at the Touquoy facility when requested by NSE in response to a complaint or concern.
Geology, Soil, and Sediment Quality	Sediment quality impacted by Project beyond natural fluctuations that affects aquatic habitats and or species negatively.	• Sediment and erosion control measures. • Design of settling ponds and outflow structures to minimize out flow velocities.
Surface Water Quality and Quantity	Disturbance Habitat loss	• Sedimentation ponds will be utilized to treat water (TSP) from surface runoff and pit water. Treated water will be allowed to discharge to the environment; • All surface water discharges from sedimentation ponds to the natural environment will be sampled as per requirements listed in industrial operating approvals and MMER to ensure water quality conforms to applicable guidelines; • Stockpiles will employ perimeter ditches to direct water to ponds. Topographic controls will ensure that overflow from extreme weather conditions, should it occur, will be directed to a spillway into the water diversion structure. • An Erosion and Sediment Control Plan will prescribe stormwater management protocols during construction and operation; • A Stormwater Management Plan will describe the construction and operation of drainage ditches and stormwater management ponds; • Diesel fuel will be stored in double-walled, aboveground storage tanks with perimeter impact protection located on a concrete pad; • Fuel storage and transfer areas will be designed to limit areas of fuel transfer and will be located a minimum of 30 m from wetlands and watercourse locations. Spill response kits will be accessible in areas of fuel transfer. A petroleum management plan will be developed. • An Emergency Response and Spill Contingency Plan will provide information on incident prevention, response procedures, and response training in the case of accidental spills; and

		• A Wetland Compensation Plan that describes an inspection and monitoring program for site and adjacent wetlands will be developed in collaboration with NSE and after engagement with the Mi'kmaq of Nova Scotia. • Ongoing review of monitoring data collected from the Touquoy facility.
Groundwater Quality and Quantity	Disturbance	• All surface water discharges from sedimentation ponds to the natural environment will be sampled as per requirements listed in industrial operating approvals and MMER to ensure water quality conforms to applicable guidelines; • An Erosion and Sediment Control Plan will prescribe stormwater management protocols during construction and operation; • A Stormwater Management Plan will describe the construction and operation of drainage ditches and stormwater management ponds; • Diesel fuel will be stored in double-walled, aboveground storage tanks with perimeter impact protection located on a concrete pad; • Fuel storage and transfer areas will be designed to limit areas of fuel transfer and will be located a minimum of 30 m from wetlands and watercourse locations. Spill response kits will be accessible in areas of fuel transfer. A petroleum management plan will be developed. • An Emergency Response and Spill Contingency Plan will provide information on incident prevention, response procedures, and response training in the case of accidental spills; and • A Wetland Compensation Plan that describes an inspection and monitoring program for site and adjacent wetlands will be developed in collaboration with NSE. • Project design includes use of pit dewatering water and collected surface water instead of groundwater for dust control. No other on-site water use except for small domestic purposes (office building less than 10 Lpm) expected. • Ongoing review of monitoring data collected from the Touquoy facility, which is compared with the approach as prescribed in the Groundwater Contingency Plan. This includes a comparison of data with baseline levels and accepted water quality guidelines, such as CCME Water Quality Guidelines for the Protection of Aquatic Life.
Wetlands	Disturbance Habitat Loss	• Wetland awareness with construction staff and personnel including awareness of wetland alteration schedules and locations of wetland habitat. • Sediment and erosion control o Manage silt-laden water through use of silt fencing, on-site drainage control and settling ponds

		o Maintain existing vegetation cover where possible and minimize overall disturbance o Manage runoff through natural vegetation where possible o Implement all erosion and sediment control structures prior to any soil disturbing activities, where applicable o Drainage structures will be incorporated where necessary o Frequent travel over erosion-prone areas will be avoided • Vegetation management in or near wetlands (i.e. to limit clearing, clearing by cutting, no herbicides, etc.); • Water management to maintain pre-construction hydrological flows; • Wetland avoidance and permitting, including engaging in the wetland alteration application process; • Limit driving and use of machinery in wetland habitat, where reasonable; • Reclamation during decommissioning, including maintenance or removal of water management structures as required, and implementation of erosion measures; • Ensure spill control and emergency planning is in effect and procedures communicated to staff; • Fuel storage and transfer areas will be designed to limit areas of fuel transfer and will be located a minimum of 30 m from wetlands and watercourse locations. Spill response kits will be accessible in areas of fuel transfer. A petroleum management plan will be developed; and • Wetland monitoring and compensation as per NSE and as part of engagement with the Mi'kmaq of Nova Scotia.
Fish and Fish Habitat	Disturbance Habitat Loss	• Sediment and erosion control o Manage silt-laden water through use of silt fencing, on-site drainage control and settling ponds o Maintain existing vegetation cover where possible and minimize overall disturbance o Manage runoff through natural vegetation where possible o Implement all erosion and sediment control structures prior to any soil disturbing activities, where applicable o Drainage structures will be incorporated where necessary o Frequent travel over erosion-prone areas will be avoided

		• Vegetation management in or near wetlands (i.e. to limit clearing, clearing by cutting, etc.) • Engage wetland and watercourse permitting processes. Loss of fish habitat will be addressed in these alteration applications • Fish habitat avoidance where possible • Fish habitat restoration activities • Maintenance of pre-construction hydrological flows into and out of down-stream surface water habitats to the extent possible • Recommended timing windows will be adhered to for potential direct loss of fish and fish habitat (to limit loss of eggs and juveniles), as directed by DFO • Fish habitat awareness with construction staff and personnel, including provision of mapping and flagging of wetlands and watercourses • Reclamation during decommissioning • Limit driving and use of machinery within wetland and watercourse habitat where practical • Spill control and planning in effect and procedures communicated to staff • Fuel storage and transfer areas will be designed to limit areas of fuel transfer and will be located a minimum of 30 m from wetlands and watercourse locations. Spill response kits will be accessible in areas of fuel transfer. A petroleum management plan will be developed. • Atlantic Gold is aware of the Wright and Hopky Guidelines For The Use Of Explosives In Or Near Canadian Fisheries Waters (DFO 1998) and will use these Guidelines in the design of final pit limits, benches, roads, and a blasting plan. • Ongoing review of surface water data to provide insight into potential effects to fish and fish habitat.
Habitat and Flora	Disturbance Habitat Loss	• Intact forest stands and wetlands will be avoided wherever possible during detailed Project planning and design in favor of previously disturbed areas (e.g., stands disturbed by timber harvesting, roads, or other development); • Ensure limits of work are maintained to avoid unnecessary habitat loss. Where natural, intact habitat cannot be avoided, minimization of total Project footprint will be considered during planning;

		Erosion and sediment control planning will be completed to ensure site runoff is not directed towards unaltered habitat, including: o Manage silt-laden water through use of silt fencing, on-site drainage control and settling ponds o Maintain existing vegetation cover where possible and minimize overall disturbance o Manage runoff through natural vegetation where possible o Implement all erosion and sediment control structures prior to any soil disturbing activities, where applicable o Drainage structures will be incorporated where necessary o Frequent travel over erosion-prone areas will be avoided The effect of dust accumulation on adjacent undisturbed vegetation can be mitigated by monitoring dust conditions and when normal precipitation levels are not enough to suppress fugitive dust, water trucks can be used to suppress dust. This reduces potential impact on fauna and improves safety and visibility for other vehicular traffic as well; Winter road maintenance will include conventional snow clearing and deposition of sand for traction control where necessary. Road salt will not be used; Haul trucks will be equipped with spill kits and instructed on their use and spill prevention and appropriate site personnel will be trained in spill isolation, containment, and recovery; A wetland alteration application will be submitted during Project planning and design to request an authorization to alter wetland habitat. Loss of function will be addressed in this wetland alteration application; and, Compensation for permanent loss of wetland function will be completed through wetland restoration activities to support no net loss of wetland function, subject to NSE approval.
Fauna	Habitat Loss Disturbance Direct Mortality	Intact forest stands and wetlands will be avoided wherever possible during detailed Project planning and design in favor of previously disturbed areas (e.g., stands disturbed by timber harvesting);

		Where natural, intact habitat cannot be avoided, minimization of total Project footprint will be considered during planning; Habitat fragmentation will be reduced by limiting the area of new roads, favoring upgrading of existing roads where possible instead; Site infrastructure will be fenced in, where practical, to reduce interactions between Project infrastructure and wildlife; A speed limit of 50 km/hr within the mine footprint and 70km/hr along the Haul Road will be implemented to reduce likelihood of collisions with fauna; An unvegetated buffer along roadsides will be maintained, where possible, to improve visibility along roadsides and reduce the potential for collisions with wildlife; Clearing and construction will be limited within wetlands that could support snapping turtles during winter hibernation period; Culverts installed within wetlands and watercourses will provide an alternative crossing location to amphibians and reptiles, thereby reducing direct mortality of species attempting to cross a road; Watering of roads during dry conditions will occur to improve safety and visibility and reduce likelihood of collisions between vehicular traffic and wildlife; Site-specific measures to protect wildlife will be addressed in the EPP; Waste must be managed to reduce attractants to opportunistic wildlife species; Erosion and sediment control planning will be completed to ensure site runoff is not directed towards unaltered habitat, including: o Manage silt-laden water through use of silt fencing, on-site drainage control and settling ponds o Maintain existing vegetation cover where possible and minimize overall disturbance o Manage runoff through natural vegetation where possible o Implement all erosion and sediment control structures prior to any soil disturbing activities, where applicable o Drainage structures will be incorporated where necessary

		o Frequent travel over erosion-prone areas will be avoided For those species reliant on wetland habitat, a wetland alteration application will be submitted during Project planning and designed to request an authorization to alter wetland habitat. Loss of function and habitat will be addressed in this wetland alteration application; and Compensation for permanent loss of wetland function will be completed through wetland restoration activities to support no net loss of wetland function, subject to NSE approval. Water management, including maintenance of pre-construction hydrological flows Spill control management Vegetation management will be conducted by cutting (i.e., no use of herbicides); Ensure all development related activity (construction areas, access roads, etc.) are located within areas where biophysical field evaluations have been completed and approvals/written authorizations are in place as required; Machinery and personnel will be instructed not to enter the habitats outside of approved Project footprint
Birds	Disturbance Habitat Loss Attraction and disorientation Mortality	Bird awareness and management, including avoiding construction during the breeding season for migratory birds, discouraging ground-nesting or burrow-nesting species, and applying a buffer zone around any identified nests for specified species during the life of the Project Conduct routine inspections of the open pit to remove any trapped or injured birds Reduce impact of light pollution on birds by minimizing on-site lighting while still allowing for safe operation, and by installing lighting which faces the ground, thereby minimizing overall light pollution in the PA; Maintain speed limits on mine roads (max. 50 km/hr within mine footprint, 70 km/hr along haul road). Reduce speed limit and install signage where specific wildlife concerns have been identified.

		Noise controlled by attenuation (the distance between a noise source and a receptor), vertical separation, and equipment design. Where there are increased dust emissions, apply water obtained from settling ponds. Compensate for lost wetland functions that support migratory birds as part of the wetland compensation plan that will be submitted to Nova Scotia Environment. Notify Environment and Climate Change Canada within 24 hours in the event of the mortality or injury of ten or more migratory birds in a single event or in the event of the mortality or injury of a migratory bird species at risk;
SOCI/SAR – Priority Fish	Habitat Loss Disturbance	• Standard mitigation for fish and fish habitat is expected to appropriately mitigate effects on priority fish species. Watercourse alteration permitting will also be required, at which time detailed fish habitat quantification and potential effects on priority fish species will be addressed. • Work with organizations to form partnerships so that data collected by any party can be used by others. • Site specific terms and conditions for alteration of watercourses which support priority fish species will be communicated to all site personnel and strictly adhered to; fish rescue will be completed within mine footprint PA prior to commencement of mine development; • All culverts to be installed will be done in accordance with the NSE Watercourse Standard (2015) to ensure fish passage through new culverts, and improving access by upgrading or removing improperly installed culverts, where possible; and, • The location of all watercourses known to support priority species will be communicated to site personnel along with recommended mitigation measures.
SOCI/SAR – Priority Vascular Flora and Lichen	Habitat Loss Disturbance	• Standard mitigation measures for wetlands and habitat and flora is expected to appropriately mitigate effects on priority vascular flora and lichens. • SOCI awareness will be communicated to all personnel, including maps and flagging. • Priority species that are located within the direct footprint of the mine infrastructure or haul road, where deemed reasonable and appropriate, will be transplanted to nearby areas where suitable habitat is present.

		• A lichen monitoring program for those lichen SAR identified outside of, but in close proximity to, the Project Area will be established to determine extent of indirect effects on those species.
SOCI/SAR – Priority Terrestrial Fauna	Habitat Loss Disturbance Direct Mortality	• Standard mitigation for terrestrial fauna applies to SAR and SOCI; • A Moose Management and Monitoring Program should be implemented during pre-construction, through operation of the Project. • Wildlife observation reporting to appropriate site personnel during construction, operation and decommissioning of Project; • Impacts to Snapping Turtles will be reduced by implementing a 30m buffer on aquatic habitat deemed suitable for Snapping Turtles, wherever possible; • Culverts will be installed in wetlands and watercourses under provincial permits as required. • Wetland and watercourse alterations • Implement signage on the haul road during operations adjacent to major stream crossings or waterbodies • Dust suppression
SOCI/SAR – Priority Birds	Disturbance Habitat Loss Attraction and disorientation Mortality	• Standard mitigation for birds applies to SAR and SOCI; • Communicate regulations related to nesting birds to all site personnel, particularly focused on those priority bird species which may be attracted to Project activities. If nesting behavior of any bird is observed, site personnel are to report this activity to Atlantic Gold personnel as defined in the EPP so appropriate mitigation measures can be implemented as necessary; and, • To limit attraction of Common Nighthawk (CONI) to the Project Area, the Project Team should limit the amount of exposed soil during nesting season, favoring to cover or revegetate soil wherever possible
Indigenous Peoples – Current and Historic Land Use	Loss of plant species, habitat loss	• Continuation of the CLC which is made of up local community representatives including two closest Mi’kmaq communities, Sipekne’katik and Millbrook First Nations • Engagement the Mi’kmaq of NS as per the engagement strategy, including specific participation in environmental monitoring and wetland compensation • Implement specific engagement activities to address interest of the residents Beaver Lake, including information sharing, site tour, etc. • Share Project benefits with the Mi’kmaq of Nova Scotia via negotiated benefits agreement(s) • Ensure no Project activities occur outside of Project Area • Minimize footprint as per Project design.

		• Implementation of mitigation and monitoring of per other VCs to minimize indirect effects.
Human Health and Socio-economic Considerations - Recreation	Disturbance	• Restriction of recreational activities within the spatial boundaries of the Project. Notification will be provided by signage. • Liaison with any local recreation groups, such as ATV associations
Human Health and Socio-economic Considerations - Traffic	Disturbance	• Regular equipment maintenance as specified by suppliers; • Limiting haul truck operational hours to 12 to 16 hours per day; • Reduce risks of a mobile equipment or haul truck accident through: o operator training; o installation of speed limit signage on the mine site and along the haul road; o installation of right-of-way signage at intersections and along the haul road; o design of intersections to NSTIR Standards; o provision of radios to all haul truck drivers for communications; and o discussions with NSTIR

10.2 Conclusions of the Proponent

The Beaver Dam Mine Project proposed by Atlantic Gold will operate as a satellite surface mine with an approximate ore extraction rate of 2 million tonnes per year. The Beaver Dam Mine Project is part of the MRC Project which also includes the existing and fully permitted Touquoy Gold Project in nearby Moose River Gold Mines, Nova Scotia.

Processing of ore from the Beaver Dam gold deposit at the existing plant at Moose River will begin upon completion of mining from the Touquoy gold deposit. The Beaver Dam Mine Project is anticipated to begin construction in 2021, come into production in 2022, cease operations in 2026 and then be reclaimed. Reclamation would occur at the Beaver Dam Mine site following cessation of production and at the Touquoy facilities associated with ore processing and tailings management from processing Beaver Dam ore.

Atlantic Gold has recognized that the quantity and unusual style of gold mineralization at the Beaver Dam mine site will support a commercially viable surface mining operation with on-site crushing and off-site processing of ore.

Atlantic Gold wishes to develop this resource in line with all applicable regulatory requirements and recognizes the significant benefits to the local economy, the Province of Nova Scotia, the Mi'kmaq of Nova Scotia, and the company in completing this Project. Atlantic Gold has designed a project that is in line with the intent of NSDNR for efficient use of mineral resources and to "*promote the concepts of environmental responsibility and sustainable development, stewardship of the mineral resource sector, and integrated resource planning.*"

All phases of the Project will provide employment opportunities for local residents and Indigenous Peoples, as well as provide tax revenue for the municipal, provincial, and federal levels of government. It is anticipated that additional labour force will be required during construction and a smaller, but still significant, labour force will be required during operation. Indirect employment will be generated by the Project through the use of external contractors and suppliers. Tax revenue in the millions of dollars per year will be generated through corporate income taxes paid by Atlantic Gold, as well as its contractors and suppliers.

As described throughout the EIS and this Summary document, Project-environment interactions are expected to occur throughout the life of the Project during the construction, operations, and decommissioning phases. These interactions are expected, manageable and are typical of environmental impacts associated with quarry and mineral extraction projects in the region.

Given the considerations identified above and based on baseline studies completed for each of the identified VCs, the Project is not expected to result in any significant residual adverse environmental effects once mitigation measures have been applied. Monitoring programs will continue throughout the life of the Project to verify the effects of the Project on the surrounding environment relative to predictions made in the environmental effects assessment. The Proponent is committed to implementing the planned mitigation measures and monitoring programs, as well as ongoing stakeholder and Mi'kmaq engagement as outlined in this submission.

11. References

AANDC 2011: Aboriginal Affairs and Northern Development Canada, Aboriginal Consultation and Accommodation – Updated Guidelines for Federal Officials to Fulfill the Duty to Consult. 2011. Retrieved from: http://www.aadnc-aandc.gc.ca/eng/1100100014664/1100100014675. Last modified: 2010-09-15.

AANDC 2017: Aboriginal Affairs and Northern Development Canada, First Nations Profiles. http://cippn-fnpim.aadnc-aandc.gc.ca/index-eng.html. Last modified: 2017-03-02. (Accessed March 2017).

Abbott, J.C. 2006-2017. OdonataCentral: An online resource for the distribution and identification of Odonata. Retrieved form: http://www.odonatacentral.org. (Accessed: Nov 2016).

Allen, A.W. & National Ecology Centre (United States Fish and Wildlife Service). 1987. Habitat suitability index models: barred owl. Biological Report 82 (10.143). 17 pp.

Alexander, D. R., Kerekes, J. J., & Sabean, B. C. (1986). Description of Selected Lake Characteristics and Occurrence of Fish Species in 781 Nova Scotia Lakes. Proceedings of the Nova Scotian Institute of Science, 36(2), 63-106.

American Eel Fact Sheet. (2006). Retrieved from https://massbay.mit.edu/seafood/americaneel.pdf

Andren, H. (1994). Effects of habitat fragmentation on birds and mammals in landscapes with different proportions of suitable habitat. *Oikos -Copenhagen*, *71*(3), 355.

Angelier, E. (2003). *Ecology of Streams and Rivers.* Enfield, USA: Science Publishers Inc.

Atlantic Canada Conservation Data Centre (ACCDC). 2014. Maritime Butterfly Atlas. Retrieved from: http://www.accdc.com/mba/index-mba.html (Accessed: Nov 2016)

ACCDC 2017: Atlantic Canada Conservation Data Centre, Rank Definitions. Retrieved from: http://www.accdc.com/en/rank-definitions.html

Ausenco 2015: Ausenco Engineering Canada Inc. NI 43-101 Technical Report, Feasibility Study for Moose River Consolidated Project, Nova Scotia.Bangs, E. E., Bailey, T. N., & Portner, M. F. (1984). Bull moose behavior and movements in relation to harvest on the Kenai National Wildlife Refuge. *Alces*, *20,* 187-207.

Beamish, R. J. (1972). Lethal pH for the white suckers, *Catostomus commersonii* (Lacepede). *Trans. Am. Fish. Soc. 101*(2), 355-358.

Bentz, J.A., A. Saxena, and D.O'Leary. 1994. Biophysical inventory of shoreland areas of the Hay - Zama Lakes, Alberta. Prepared by Geowest Environmental Consultants Ltd. for Resource Information Division, Alberta Environmental Protection. Edmonton, AB. 105 pp.

Bird Studies Canada. (2007). Nova Scotia Nocturnal Owl Survey. Retrieved from http://www.bsc-eoc.org/download/NS%20owl%20survey%20instructions.pdf?_sm_au_=iVV411JJDR6VF15T

Bird Studies Canada. (n.d.). Second Atlas of Breeding Birds of the Maritime Provinces: Breeding Evidence Codes. Retrieved from http://www.mba-aom.ca/jsp/codes.jsp?lang=en&pg=breeding&_sm_au_=iVV411JJDR6VF15T

Bouchard, J., A. T. Ford, F. E. Eigenbrod, and L. Fahrig. 2009. Behavioral responses of northern leopard frogs (Rana pipiens) to roads and traffic: implications for population persistence. Ecology and Society 14 (2): 23. Retrieved from: http://www.ecologyandsociety.org/vol14/iss2/art23/ (Accessed: Nov 2016)

Brown, T.G., Runciman, B., Bradford, M.J., and Pollard, S. 2009. A biological synopsis of yellow perch (Perca flavescens). Can. Manuscr. Rep. Fish. Aquat. Sci. 2883: v + 28 p.

Brown, T.G., Runciman B., Pollard, S., Grant, A.D.A., and Bradford, M.J. 2009. Biological synopsis of smallmouth bass (*Micropterus dolomieu*). Can. Manuscr. Rep. Fish. Aquat. Sci. 2887: v + 50 p.

Buckmaster, G., Todd, M., Smith, K., Bonar, R., Beck, B., Beck, J., & Quinlan, R. (1999). Elk Winter Foraging Habitat Suitability Index Model Version 5. Retrieved from https://friresearch.ca/sites/default/files/null/HSP_1999_10_Rpt_ElkWinterForaging.pdf

Campbell, R.W., M.K. McNicholl, R.M. Brigham, and J. Ng. 2006. Wildlife data centre featured species: Common Nighthawk. Wildlife Afield 3:32-71.

CCME 1999a: Canadian Council of Ministers of the Environment, Canadian Environmental Quality Guidelines, Water Quality Guidelines for the Protection of Freshwater Aquatic Life. 2015. Retrieved from: http://ceqg-rcqe.ccme.ca/en/index.html#void.

CCME1999b: Canadian Council of Ministers of the Environment, Canadian Environmental Quality Guidelines, Soil Quality Guidelines for the Protection of Environmental and Human Health. 2015. Retrieved from: http://ceqg-rcqe.ccme.ca/en/index.html#void.

CCME 2000: Canadian Council of Ministers of the Environment, Canadian Environmental Quality Guidelines, Canada Wide Standards for Particulate Matter and Ozone. 2000. Retrieved from: http://www.ccme.ca/en/resources/air/pm_ozone.html.

CCME 2001: Canadian Council of Ministers of the Environment, Canadian Environmental Quality Guidelines, Sediment Quality Guidelines for the Protection of Aquatic Life. 2015. Retrieved from: http://ceqg-rcqe.ccme.ca/en/index.html#void.

CEAA 2013a: Canadian Environmental Assessment Agency, Operational Policy Statement Assessing Cumulative Environmental Effects under the *Canadian Environmental Assessment Act, 2012*. 2015. Retrieved from: http://www.ceaa.gc.ca/default.asp?lang=En&n=1DA9E048-1. Last modified: 2016-07-06.

CEAA 2013b: Canadian Environmental Assessment Agency, Operational Policy Statement Addressing “Purpose of” and “Alternative Means” under the *Canadian Environmental Assessment Act, 2012*. 2015. Retrieved from: http://www.ceaa.gc.ca/default.asp?lang=En&n=1B095C22-1. Last modified: 2016-07-06.

CEAA 2014a: Canadian Environmental Assessment Agency, Draft Technical Guidance for Assessing Cumulative Environmental Effects under the *Canadian Environmental Assessment Act,* *2012*. 2014. Retrieved from: http://www.ceaa.gc.ca/default.asp?lang=en&n=B82352FF-1&offset=&toc=hide. Last modified: 2016-07-06.

CEAA 2014b: Canadian Environmental Assessment Agency, Technical Guidance for Assessing Physical and Cultural Heritage or any Structure, Site, or Thing that is of Historical, Archaeological, Paleontological, or Architectural Significance under the *Canadian Environmental Assessment Act, 2012*. 2015. Retrieved from: http://www.ceaa.gc.ca/default.asp?lang=en&n=536A4CFE-1. Last modified: 2016-07-06.

CEAA 2014c: Canadian Environmental Assessment Act, Reference Guide Considering Aboriginal Traditional Knowledge in Environmental Assessments Conducted Under the *Canadian Environmental Assessment Act, 2012*. 2014. Retrieved from: http://www.ceaa.gc.ca/default.asp?lang=en&n=C3C7E0D3-1. Last modified: 2016-07-06.

CEAA 2015a: Canadian Environmental Assessment Agency, Operational Policy Statement Determining Whether a Designated Project is Likely to Cause Significant Adverse Environmental Effects under the *Canadian Environmental Assessment Act, 2012*. 2015. Retrieved from: http://www.ceaa.gc.ca/default.asp?lang=En&n=363DF0E1-1. Last modified: 2016-07-06.

CEAA 2015b: Canadian Environmental Assessment Agency, Technical Guidance for Assessing the Current Use of Lands and Resources for Traditional Purposes under the *Canadian Environmental Assessment Act, 2012*. 2015. Retrieved from: http://www.ceaa.gc.ca/default.asp?lang=en&n=0CF7E820-1. Last modified: 2016-07-06.

CEAA 2016: Canadian Environmental Assessment Agency/Nova Scotia Environment, Guidelines for the Preparation of an Environmental Impact Statement Pursuant to the *Canadian Environment Assessment Act, 2012* and Nova Scotia Registration Document Pursuant to the *Nova Scotia Environment Act*, Beaver Dam Mine. 2016. 38 pp.

Canadian Rivers Institute. (n.d.). Blacknose Dace, *Rhinichthys atratulus*. Retrieved from http://www.unb.ca/research/institutes/cri/links/inlandfishesnb/Species/blacknosedace.html

CRA 2007: Conestoga-Rovers & Associates Ltd. (CRA). 2007. Environmental Assessment Registration Document for the Touquoy Gold Project.

CRA 2007a: Conestoga-Rovers & Associates Ltd. (CRA). 2007. Focus Report, Touquoy Gold Project, Moose River Gold Mines, Nova Scotia

COSEWIC 2006. COSEWIC assessment and status report on the Rusty Blackbird *Euphagus carolinus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 28 pp.

COSEWIC 2007a. COSEWIC assessment and status report on the Common Nighthawk *Chordeiles minor* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 25 pp.

COSEWIC 2007b. COSEWIC assessment and update status report on the Peregrine Falcon *Falco peregrinus* (*pealei* subspecies - *Falco peregrinus* and *pealei anatum/tundrius* - *Falco peregrinus anatum/tundrius*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 45 pp.

COSEWIC. 2008. COSEWIC assessment and status report on the Canada Warbler *Wilsonia Canadensis* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 35 pp.

COSEWIC. 2010. COSEWIC assessment and status report on the Atlantic salmon *Salmo salar* (Nunavik population, Labrador population, Northeast Newfoundland population, South Newfoundland population, Southwest Newfoundland population, Northwest Newfoundland population, Quebec Eastern North Shore population, Quebec Western North Shore population, Anticosti Island population, Inner St. Lawrence population, Lake Ontario population, Gaspé-Southern Gulf of St. Lawrence population, Eastern Cape Breton population, Nova Scotia Southern Upland population, Inner Bay of Fundy population, Outer Bay of Fundy population) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xlvii + 136 pp.

COSEWIC. 2011. COSEWIC assessment and status report on the Barn Swallow *Hirundo rustica* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. ix + 37 pp.

COSEWIC. 2012. COSEWIC assessment and status report on the Eastern Wood-pewee in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. x + 39 pp.

COSEWIC. 2013. Committee on the Status of Endangered Wildlife in Canada, COSEWIC assessment and status report on the American Eel *Anguilla rostrata* in Canada. Ottawa. xii + 109 pp. Retrieved from: http://www.registrelep-sararegistry.gc.ca/sar/assessment/status_e.cfm (Accessed November 2016)

Conference Board of Canada 2016. Provincial Long-Term Economic Forecast for Nova Scotia: 2016. 17 May 2017, Retrieved form: http://www.conferenceboard.ca/e-library/abstract.aspx?did=8008

Cornell Lab of Ornithology. (n.d.a). Chimney Swift. Retrieved from https://www.allaboutbirds.org/guide/Chimney_Swift/lifehistory

Cornell Lab of Ornithology. (n.d.b). Olive-sided Flycatcher. Retrieved from https://www.allaboutbirds.org/guide/Olive-sided_Flycatcher/lifehistory

Da Silva, A., Samplonius, J. M., Schlicht, E., Valcu, M., & Kempenaers, B. (2014). Artificial night lighting rather than traffic noise affects the daily timing of dawn and dusk singing in common European songbirds. *Behavioural Ecology*, *25*(5), 1037-1047.

Da Silva, A., Valcu, M., & Kempenaers, B. (2015). Light pollution alters the phenology of dawn and dusk singing in common European songbirds. Phil. Trans. R. Soc. B 370: 20140126. http://dx.doi.org/10.1098/rstb.2014.0126

DeRomilly and deRomilly Limited, Dillon Consulting Limited, Alan Bell Environmental Management Services, Cameron Consulting, Environment Canada, Inter-Cultural Development Innovations (2005). Adapting to a Changing Climate in Nova Scotia: Vulnerability Assessment and Adaptation Options. Retrieved from: https://climatechange.novascotia.ca/sites/default/files/uploads/Adapting_to_a_Changing_Climate_in_NS.pdf

Demarchi, M. W. (2003). Migratory Patterns and Home Range Size of Moose in the Central Nass Valley, British Columbia. *Northwestern Naturalist*, *84*(3), 135-141.

Elphick, C. S., and T. L. Tibbitts. 1998. Greater Yellowlegs (*Tringa melanoleuca*). In The Birds of North America, No. 355 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Environment Canada (EC). (2012). Canadian Aquatic Biomonitoring Network Field Manual: Wadeable Streams. Retrieved from http://publications.gc.ca/collections/collection_2012/ec/En84-87-2012-eng.pdf

Environment Canada. 2015. Recovery Strategy for Little Brown Myotis (*Myotis lucifugus*), Northern Myotis (*Myotis septentrionalis*), and Tri-colored Bat (*Perimyotis subflavus*) in Canada [Proposed]. *Species at Risk Act* Recovery Strategy Series. Environment Canada, Ottawa. ix + 110 pp.

Environment Canada. 2016. Recovery Strategy for the Common Nighthawk (*Chordeiles minor*) in Canada. *Species at Risk Act* Recovery Strategy Series. Environment Canada, Ottawa. vii + 49 pp.

ECCC 1991: Environment and Climate Change Canada, Federal Policy on Wetland Conservation. 1991. Retrieved from: http://publications.gc.ca/site/eng/100725/publication.html. Last modified: 2013-04-03.

ECCC 2001: Environment and Climate Change Canada, Guidance Document for Flow Measurement of Metal Mining Effluents. 2001. Retrieved from: http://publications.gc.ca/site/eng/9.535766/publication.html?pedisable=true. Last modified: 2013-04-03.

ECCC 2002: Environment and Climate Change Canada, Guidance Document for Sampling and Analysis of Metal Mining Effluents. 2002. Retrieved from: http://publications.gc.ca/site/eng/236853/publication.html. Last modified: 2013-04-03.

ECCC 2009: Environment and Climate Change Canada, Environmental Code of Practice for Metal Mines. 2009. Retrieved from: https://www.ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=CBE3CD59-1. Last modified: 2015-05-07.

ECCC 2011: Environment and Climate Change Canada, Guidelines for the Assessment of Alternatives for Mine Waste Disposal. 2011. Retrieved from: http://ec.gc.ca/pollution/default.asp?lang=En&n=125349F7-1. Last modified: 2013-09-17.

ECCC 2012: Environment and Climate Change Canada, Streamlining the Approvals Process for Metal Mines with Tailings Impoundment Areas. 2012. Retrieved from: https://www.ec.gc.ca/pollution/default.asp?lang=En&n=EFAD32D1-1. Last modified: 2012-12-13.

ECCC. 2015. General Nesting Periods of Migratory Birds in Canada. Retrieved from https://www.ec.gc.ca/paom-itmb/default.asp?lang=En&n=4F39A78F-1%20-%20_01_1

ECCC 2016a: Environment and Climate Change Canada, Guide for Reporting to the National Pollutant Release Inventory (NPRI) 2016 and 2017. 2016 Retrieved from: https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=28C24172-1. Last modified: 2016-07-11.

ECCC 2016b: Environment and Climate Change Canada, National Inventory Report 1990-2014: Greenhouse Gas Sources and Sinks in Canada – Part 3. Retrieved from: Fahrig, L. Rytwinski, T. Effects of Roads on Animal Abundance: an Empirical Review and Synthesis. Ecology and Society 14(2):21.

ECCC 2016c. Environment and Climate Change Canada, Recovery Strategy for the Wood Turtle (*Glyptemys insculpta*) in Canada [Proposed]. *Species at Risk Act* Recovery Strategy Series. Environment Canada, Ottawa. v + 48 pp.

ECCC 2016d: Environment and Climate Change Canada, Management Plan for the Snapping Turtle (Chelydra serpentina) in Canada [Proposed]. Species at Risk Act Management Plan Series. Ottawa, Environment and Climate Change Canada, Ottawa, iv + 39 p.

ECCC 2016e: Environment and Climate Change Canada, Lightning Maps and Statistics (1999 – 2013). Retrieved from: https://ec.gc.ca/foudre-lightning/default.asp?lang=En&n=C4E86962-1. Last modified 2016-06-21. Accessed 2017-02-07.

Environmental Laboratory. (1987). "Corps of Engineers Wetlands Delineation Manual," Technical Report Y-87-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Fahrig, L. Rytwinski, T. Effects of Roads on Animal Abundance: an Empirical Review and Synthesis. Ecology and Society 14(2):21.

Farmer, A. M. 1993. The effects of dust on vegetation – a review. *Environmental Pollution*, 79: 63-75.

Fisheries and Oceans Canada. (2003). Interim Policy for the Use of Backpack Electrofishing Units. Retrieved from http://www.dfo-mpo.gc.ca/Library/273626.pdf?_sm_au_=iVV40qq7F24qKss5

Fisheries and Oceans Canada. 2012. Temperature threshold to define management strategies for Atlantic salmon (*Salmo salar*) fisheries under environmentally stressful conditions. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2012/019.

Fisheries and Oceans Canada. 2013. Recovery Potential Assessment for Southern Upland Atlantic Salmon. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2013/009.

Fisheries and Oceans Canada. 2016a. Atlantic Salmon (Southern Uplands Designatable Unit). Retrieved from: http://www.dfo-mpo.gc.ca/species-especes/profiles-profils/atlanticsalmon-SU-saumonatlantique-eng.html.

Fisheries and Oceans Canada. 2016b. Management Plan for the Brook Floater (*Alasmidonta varicosa*) in Canada [Proposed]. *Species at Risk Act* Management Plan Series. Department of Fisheries and Oceans Canada, Ottawa. iv + 41 pp.

Fraser, D., Arthur, D., Morton, J. K., & Thompson, B. K. (1980). Aquatic feeding by moose Alces alces in a Canadian lake. Holarctic Ecology, 3(3).

Geist, V. (1963). On the Behaviour of the North American Moose (*Alces alces* andersoni Peterson 1950) in British Columbia. *Behaviour*, *20*(3/4), 377-416.

GHD 2015: GHD Limited, Beaver Dam Mine Project Description. 2015. 67 pp.

GHD 2016: GHD Limited, Beaver Dam Mine Project Update, CEAA Reference No. 80111, December 13, 2016.

Goulet, L. A. (1985). Winter habitat selection by moose in northern British Columbia. *Alces*, 21, 103-125.

Government of Canada. (1985). Fisheries Act. Retrieved from http://laws-lois.justice.gc.ca/PDF/F-14.pdf

Government of Canada. (1994). Migratory Birds Convention Act. Retrieved from http://laws-lois.justice.gc.ca/PDF/M-7.01.pdf

Government of Canada. (2002). Species at Risk Act. Retrieved from http://laws-lois.justice.gc.ca/PDF/S-15.3.pdf

Government of Nova Scotia. (1989). Wildlife Act. Retrieved from http://www.nslegislature.ca/legc/statutes/wildlife.pdf

Guertin, G., Doucet, G. J., & Weary, G. C. (1984). Moose Distribution and Winter Habitat on the Lower North Shore of the St. Lawrence River – Quebec. *Alces* 20, 27-45.

Halfyard, E.A. and Ferguson, G. 2009. Assessment of the 2009 West River, Sheet Harbour Atlantic Salmon Smolt Migration, Nova Scotia Salmon Association, June 2009. Retrieved from: http://www.nssalmon.ca/docs/WRSH_Smolt_Estimation_2009.pdf (Accessed December 2016)

Hauge, T. M., & Keith, L. B. (1981). Dynamics of Moose Populations in Northeastern Alberta. *Journal of Wildlife Management*, *45*(3), 573-597.

Hawk Monitoring Association of North America. (1998). Daily Report Form. Retrieved from http://rmbo.org/v3/Portals/5/Datasheets/HMANA_data_form.pdf?_sm_au_=iVVD3HHZw214RrD5

HC 2015: Health Canada (2015). Useful Information for Environment Assessments. http://publications.gc.ca/collections/collection_2015/sc-hc/H128-1-10-599-eng.pdf. Accessed March 2017.

Hegmann, G., C. Cocklin, R. Creasey, S. Dupuis, A. Kennedy, L. Kingsley, W. Ross, H. Spaling and D. Stalker. 1999. *Cumulative Effects Assessment Practitioners Guide*. Prepared by AXYS Environmental Consulting Ltd. and the CEA Working Group for the Canadian Environmental Assessment Agency, Hull, Quebec.

Heimbuch, D. G., Wilson, H. T., Weisberg, S. B., Voslash, J. H., & Kazyak, P. F. (1997). Estimating Fish Abundance in Stream Surveys Using Double-Pass Removal Sampling. *Transactions of the American Fisheries Society*, *126*(5), 795-803. doi:10.1577/1548-8659(1997)126<0795:EFAISS>2.3.CO;2

Hennick, E., Poole, J (2016). DP ME 10, Version 6, 2016. Nova Scotia Abandoned Mine Openings Database. Nova Scotia Department of Natural Resources, Minerals and Energy Branch.

Hilchey, J.D., Cann, D.B., MacDougall, J.I. 1963. Soil Survey of Halifax County, Nova Scotia. Report No. 13, Nova Scotia Soil Survey. Canada Department of Agriculture and Nova Scotia Department of Agriculture. 53 pp.

Hinton, Michael G. and Mark N. Maunder. 2003. Methods for standardizing CPUE and how to select among them. Inter-American Tropical Tuna Commission, July 2003. Retrieved from https://spccfpstore1.blob.core.windows.net/digitallibrary-docs/... Dec 2016

HRM 1996a: Halifax Regional Municipality, Musquodoboit Valley/Dutch Settlement Municipal Planning Strategy. 2014. Retrieved from: http://www.region.halifax.ns.ca/planning/MusquodoboitValleyDutchSettlementPlanArea.php. Last modified: 2014-12-1.

HRM 1996b: Halifax Regional Municipality, Musquodoboit Valley/Dutch Settlement Land Use By-law. 2014. Retrieved from: http://www.region.halifax.ns.ca/planning/MusquodoboitValleyDutchSettlementPlanArea.php. Last modified: 2014-12-1.

HRM 1996c: Halifax Regional Municipality, Eastern Shore (East) Municipal Planning Strategy. 2006. Retrieved from: http://www.region.halifax.ns.ca/planning/EasternShoreEastPlanArea.php. Last modified: 2014-11-24.

HRM 1996d: Halifax Regional Municipality, Eastern Shore (East) Land Use By-law. 2014. Retrieved from: http://www.region.halifax.ns.ca/planning/EasternShoreEastPlanArea.php. Last modified: 2014-11-24.

Hall, R. J., Likens, G. E., Fiance, S. B., & Hendrey, G. R. (1980). Experimental acidification of a stream in the Hubbard Brook experimental forest, New Hampshire. *Ecology*, *61*(4), 976-989.

Hussain, Q. A., & Pandit, A. K. (2012). Macroinvertebrates in streams: A review of some ecological factors. *International Journal of Fisheries and Aquaculture, 4*(7), 114-123.

Important Bird Areas Canada. (n.d.). Eastern Shore Islands. Retrieved from http://www.ibacanada.ca/site.jsp?siteID=NS027&_sm_au_=iVVD3HHZw214RrD5

Jessop, B. M. (1995). Justification for, and status of, American eel elver fisheries in Scotia-Fundy Region. Retrieved from http://www.dfo-mpo.gc.ca/CSAS/Csas/DocREC/1995/1995_002_e.pdf

Jones, J., and Francis, C. M. (2003). The effects of light characteristics on avian mortality at lighthouses. *Journal of Avian Biology*, *34*(4), 328-333.

Kalff, J. (2002). *Limnology: Inland Water Ecosystems*. San Francisco, United States: Pearson Education.

Kelly, D. (2014). White Sucker. Retrieved from http://www.lakescientist.com/lake-facts/fish/white-sucker/

Krieger, D. A., J. W. Terrell, and P. C. Nelson. 1983. Habitat suitability information: Yellow perch. U.S. Fish Wildl. Servo FWS/OBS-83/10.55. 37 pp.

KMKNO 2007: Kwilmu'kw Maw-klusuaqn Negotiation Office, Mi'kmaq Ecological Knowledge Study Protocol, 2nd Edition. 2007. Retrieved from: http://mikmaqrights.com/consultation/meks-protocol/.

Keppie, J.D. (compiler). 2000. Geological Map of the Province of Nova Scotia; Nova Scotia Department of Natural Resources, Minerals and Energy Branch, Map ME 2000-1, scale 1:500,000.

Keys, K., Neily, P., Quigley, E., and Stewart, B. 2001. Forest Ecosystem Classification for Nova Scotia Part III: Ecosites (2010), Nova Scotia Department of Natural Resources, Halifax, Report 2011-2. Retrieved form: https://www.novascotia.ca/natr/library/forestry/reports/Ecosites.pdf (Accessed Nov 2016)

KPMG 2015: KPMG International, Economic Impact Assessment of Atlantic's Moose River Consolidated Gold Projects in Nova Scotia. 2015. 16 pp.

Langille, Chris and O'Bryan, Peter, 2015. Beaver Dam Gold Project, Nova Scotia. Geotechnical Assessment, Open Pit Mining. Report 15007. Peter O'Bryan and Associates May 2015.

Langley, M.A., & D.H. Pletscher. (1994). Calving areas of moose in northwestern Montana and southeastern British Columbia. *Alces*, *30*, 127-135.

Lauff, R. F. (2009). First nest records of the Boreal Owl Aegolius funereus in Nova Scotia, Canada. In: Johnson, D.H., Van Nieuwenhuyse, D. & Duncan, J. R. (eds).
Proc. Fourth World Owl Conf. Oct–Nov 2007, Groningen, The Netherlands.
Ardea 97(4): 497–502.

Lin, Chang. L. (1970). Hydrogeology of the Musquodoboit River Valley, Nova Scotia. Retrieved from: https://novascotia.ca/nse/groundwater/docs/GroundwaterResourcesReport_MusquodobitRiverValley.pdf. Accessed March 2017.

Lockwood, Roger N. 2000. Conducting roving and access site angler surveys. Chapter 14 in Schneider, James C. (ed.) 2000. Manual of fisheries survey methods II: with periodic updates. Michigan Department of Natural Resources, Fisheries Special Report 25, Ann Arbor.

Lundmark, C., & Ball, J. P. (2008). Living in Snowy Environments: Quantifying the Influence of Snow on Moose Behavior. *Arctic, Antarctic, and Alpine Research*, *40*(1), 111-118. doi:10.1657/1523-0430(06-103)[LUNDMARK]2.0.CO;2

MacGregor R., Greig L., Dettmers J., Allen W., Haxton T., Casselman J., and McDermott L. 2011. American Eel in Ontario: Past and Present Abundance, Principles, Approaches, Biological Feasibility and Importance of Recovery. Version 5.1; February 2 Retrieved from: http://files.ontario.ca/environment-and-energy/species-at-risk/mnr_sar_rs_amr_eel_en.pdf (Accessed July 2016)

McLaren, B. E., Taylor, S., & Luke, S. H. (2009). How Moose Select Forested Habitat in Gros Morne National Park, Newfoundland. *Alces*, *45*.

McMullin, R. T., Duinker, P. N., Cameron, R. P., Richardson, D. H. S., and Brodo, I. M. (2008). Lichens of Coniferous Old-Growth Forests of Southwestern Nova Scotia, Canada: Diversity and Present Status, *The Bryologist*, *111*(4), 620-637.

Merendino, M. T., & Ankney, C. D. (1994). Habitat use by mallards and American black ducks breeding in Ontario. *The Condor*, *96*(2), 411-421.

Mersey Tobeatic Research Institute. 2008. Species at Risk in Nova Scotia: Identification and Information Guide. Retrieved from http://www.speciesatrisk.ca/SARGuide/download/SAR%20Guide.pdf

Milko, R. (1998). Migratory Birds Environmental Assessment Guideline. Retrieved from http://www.collectionscanada.gc.ca/eppp-archive/100/200/301/environment_can/cws-scf/occasional_paper-e/n110/html/publications/eval/mig/index_e.cfm

Moseley, M. 2007. Records of Bats (CHIROPTERA) at Caves and Mines in Nova Scotia. Curatorial Report Number 99, Nova Scotia Museum, Halifax: 21 p.

National Gypsum. 2015. Retrieved from: www.nationalgypsum.com. (Access February 2017).

Neily, P.D., Quigley, E., Benjamin, L., Stewart, B., and Duke, T. 2003. Ecological Land Classification for Nova Scotia, Revised Edition 2005. Report DNR 2005 -. 72 pp.

Neily, P., Basquill, S., Quigley, E., Stewart, B. and Keys, K. 2001. Forest Ecosystem Classification for Nova Scotia Part I: Vegetation Types (2010), Nova Scotia Department of Natural Resources, Halifax, Report 2011-1. Retrieved form: http://novascotia.ca/natr/forestry/veg-types/printable.asp (Accessed Nov 2016)

Neumann, W. 2009. Moose Alces alces behaviour related to human activity. Ph.D. Thesis, Swedish University of Agricultural Sciences, 56 pp.

New Brunswick Aquatic Resources Data Warehouse, New Brunswick Department of Natural Resources and Energy, & New Brunswick Wildlife Council. (2002, updated 2006). Fisheries Data Collection Forms Manual. Retrieved from http://www.unb.ca/research/institutes/cri/_resources/downloads/nbaquaticdatawarehouse/forms/Fisherieddatacollectionformsmanuamay2006.pdf

NPA 2014: Transport Canada, Navigation Protection Act. 2014. Retrieved from: http://laws-lois.justice.gc.ca/eng/acts/N-22/. Last modified: 2016-07-15.

NRCAN 2015. Natural Resources Canada, Simplified Seismic Hazard Map for Canada. 2015. Retrieved from: http://www.earthquakescanada.nrcan.gc.ca/hazard-alea/simphaz-en.php. Last modified: 2016-02-10.

NRCAN 2016. Natural Resources Canada, Earthquake Zones in Eastern Canada. 2016. Retrieved from: http://www.earthquakescanada.nrcan.gc.ca/zones/eastcan-en.php#NASZ. Last modified: 2016-02-10.

Newfoundland and Labrador Department of Environment and Climate Change. (n.d.). White Sucker. Retrieved from http://www.ecc.gov.nl.ca/wildlife/all_species/animals/inland_fish/white_sucker.html

New Hampshire Fish and Game Department. 2015. Species profiles: Common Nighthawk Chordeiles minor. Pages A121- A128 in New Hampshire Wildlife Action Plan. Retrieved from http://www.wildlife.state.nh.us/wildlife/documents/wap/appendixa-birds.pdf

Nichols, J. D., Hines, J. E., Sauer, J. R., Fallon, J. E., & Heglund, P. J. (2000). A double-observer approach for estimating detection and probability and abundance from point counts. *The Auk*, *117*(2), 393-408.

Nova Scotia Department of Agriculture and Fisheries. (2005). Nova Scotia Trout Management Plan. Retrieved from https://novascotia.ca/fish/documents/special-management-areas-reports/NSTroutManplandraft05.pdf

Nova Scotia Department of Natural Resources. 2007. Recovery Plan for Moose (*Alces alces Americana*) in Mainland Nova Scotia.

NSE 1988: Nova Scotia Environment, Erosion and Sediment Control Handbook for Construction Sites. 1988. Retrieved from: http://www.novascotia.ca/nse/surface.water/guidelines.asp. Last modified: 2014-03-31.

NSE 1990: Nova Scotia Environment, Guidelines for Environmental Noise Measurement and Assessment. 2005. Retrieved from: http://www.noise-ordinances.com/wp-content/uploads/2015/09/EnvironmentalNoiseMeasurement.pdf.

NSE 2001: Nova Scotia Environment, A Proponent's Guide to Environmental Assessment. 2014. Retrieved from: https://www.novascotia.ca/nse/ea/pubs.asp. Last modified: 2014-03-31.

NSE 2002a: Nova Scotia Environment, Storm Drainage Works Approval Policy. 2003. Retrieved from: https://www.novascotia.ca/nse/dept/docs.policy/Policy-Storm.Drainage.Works.Approval.pdf.

NSE 2002b: Nova Scotia Environment, Guide to Preparing an EA Registration Document for Mining Developments in Nova Scotia. 2009. Retrieved from: https://www.novascotia.ca/nse/ea/pubs.asp. Last modified: 2014-03-31.

NSE 2005: Nova Scotia Environment, Guide to Addressing Wildlife Species and Habitat in an EA Registration Document. 2009. Retrieved from: https://www.novascotia.ca/nse/ea/pubs.asp. Last modified: 2014-03-31.

NSE 2009: Nova Scotia Environment, Toward a Greener Future: Nova Scotia's Climate Change Action Plan. 2009. Retrieved from: https://climatechange.novascotia.ca/.

NSE 2009a: Nova Scotia Environment, Guide to Addressing Wildlife Species and Habitat in an EA Registration Document, 2009. Retrieved from: http://www.novascotia.ca/nse/ea/docs/EA.Guide-AddressingWildSpecies.pdf

NSE 2010: Nova Scotia Environment, Water for Life: Nova Scotia's Water Resource Management Strategy. 2010. Retrieved from: https://www.novascotia.ca/nse/water.strategy/. Last modified: 2014-03-31.

NSE 2011a: Nova Scotia Environment, Guide to Consider Climate Change in Project Development in Nova Scotia. 2011. Retrieved from: https://www.novascotia.ca/nse/ea/pubs.asp. Last modified: 2014-03-31.

NSE 2011b: Nova Scotia Environment, Nova Scotia Wetland Conservation Policy. 2011. Retrieved from: https://www.novascotia.ca/nse/wetland/conservation.policy.asp. Last modified: 2014-03-31.

NSE 2011c: Nova Scotia Environment, Guide to Considering Climate Change in Environmental Assessment in Nova Scotia. 2011. Retrieved from: https://www.novascotia.ca/nse/ea/pubs.asp. Last modified: 2014-03-31.

NSE 2014: Nova Scotia Environment, Nova Scotia Contaminated Sites Regulations, Environmental Quality Standards for Contaminated Sites. 2014. Retrieved from: https://www.novascotia.ca/nse/contaminatedsites/. Last modified: 2015-08-20.

NSE 2015a: Nova Scotia Environment, Guide to Altering Watercourses. 2015. Retrieved from: https://www.novascotia.ca/nse/watercourse-alteration/. Last modified: 2015-06-10.

NSE 2015b: Nova Scotia Environment, Nova Scotia Watercourse Alterations Standard. 2015. Retrieved from: https://www.novascotia.ca/nse/watercourse-alteration/. Last modified 2015-06-10.

NSE 2015c: Nova Scotia Environment, Nova Scotia Groundwater Observation Well Network, 2015 Report. August 2015. Retrieved from: https://novascotia.ca/nse/groundwater/groundwaternetwork.asp. Accessed March 2017.

NSDNR, 2006: Nova Scotia Department of Natural Resources, Compilation of Seabright Resources Inc. Till and Soil Geochemical Data over the Meguma Terrane, Nova Scotia, 1986-1988. Retrieved from: https://novascotia.ca/natr/meb/download/dp134.asp.

NSDNR 2011a: Nova Scotia Department of Natural Resources, From Strategy to Action, An Action Plan for the Path We Share, A Natural Resource Strategy for Nova Scotia. 2011. Retrieved from: http://novascotia.ca/natr/strategy/. Last modified: 2015-04-02.

NSDNR 2011b: Nova Scotia Department of Natural Resources, The Path We Share: A Natural Resource Strategy for Nova Scotia 2011-2020. 2011. Retrieved from: http://novascotia.ca/natr/strategy/. Last modified: 2015-04-02.

NSDNR, 2012: Nova Scotia Department of Natural Resources, Endangered Mainland Moose Special Management Practices. Retrieved from: http://novascotia.ca/natr/wildlife/habitats/terrestrial/pdf/SMP_Mainland_Moose.pdf (Accessed November 2017)

NSDNR, 2017: Nova Scotia Department of Natural Resources, Nova Scotia Forest Inventory. Retrieved from: https://novascotia.ca/natr/forestry/GIS/forest-inventory.asp. (Accessed Jan 2017).

NSDNR 2014: Nova Scotia Department of Natural Resources, Reading Room 1: The Story of Glaciers in Maritime Canada. 2014. Retrieved from: http://novascotia.ca/natr/meb/fieldtrip/glacier.asp. Last modified: 2014-09-29.

NSDNR, 2006a: Nova Scotia Department of Natural Resources, Till Geochemical Survey over Mainland Nova Scotia, 1977-1982. Retrieved from: https://novascotia.ca/natr/meb/download/dp138.asp.

NSOAA 2009: Nova Scotia Office of Aboriginal Affairs, Proponents' Guide: The Role of Proponents in Crown Consultation with the Mi'kmaq of Nova Scotia. 2012. Retrieved from: http://novascotia.ca/abor/office/what-we-do/consultation/. Last modified: 2015-06-01.

NSTIR 1997: Nova Scotia Department of Transportation and Infrastructure Renewal, Nova Scotia Standard Specifications: Highway Construction and Maintenance. 2014. Retrieved from: https://novascotia.ca/tran/publications/standard.pdf. Last modified: 2014-02-01.

NSTIR 2007: Nova Scotia Department of Transportation and Infrastructure Renewal, Generic Environmental Protection Plan for Construction of 100 Series Highways. 2007. Retrieved from: https://novascotia.ca/tran/works/enviroservices/EPP100series/Generic%20EPP_July%202007.pdf. Last modified: 2007-07-01.

NSFTB 2016: Nova Scotia Finance and Treasury Board. Current Economic Environment and Outlook – Nova Scotia, April 21 2016. Retrieved from: http://www.novascotia.ca/finance/statistics/topic_news.asp?id=11779&fto=22v&rdval=2016-04 Last modified 2016-04.

Nova Scotia Salmon Association (n.d.). Adopt-a-Stream, Section 6: Fish Facts. Rretrieved from: http://manual.adoptastream.ca/sec6_3.html#7. Accessed March 2017.

Odonata Central. (n.d.). Odonata Central. Retrieved from http://www.odonatacentral.org/index.php/PageAction.get/name/HomePage

Ontario Freshwater Fishes Life History Database. (n.d.). Eastern Blacknose Dace. Retrieved from http://www.ontariofishes.ca/fish_detail.php?FID=53

OMOE 2003: Ontario Ministry of the Environment, Stormwater Management Planning and Design Manual. 2003. Retrieved from: https://www.ontario.ca/document/stormwater-management-planning-and-design-manual. Last modified: 2014-09-23.

Ortega, Y., and Capen, D.E. 2002. Roads as edges: Effects on birds in forested landscapes. *Forest Science*, *48*(2), 381.

Osko, T. J., Hiltz, M. N., Hudson, R. J., and Wasel, S. M. (2004). Moose habitat preferences in response to changing availability. *Journal of Wildlife Management*, *68*(3), 576-584. doi: 10.2193/0022-541X(2004)068[0576:MHPIRT]2.0.CO;2

Parker, G. 2003. Status Report on the Eastern Moose (*Alces alces americana* Clinton) in Mainland Nova Scotia. Retrieved from: https://www.novascotia.ca/natr/wildlife/large-mammals/pdf/StatusReportMooseNS.pdf

Peek, J. M., Urich, D. L., & Mackie, R. J. (1976). Moose habitat selection and relationships to forest management in northeastern Minnesota. *Wildlife Monographs*, *48*, 3-65.

Peter Clifton and Associates 2015: Peter Clifton and Associates, Assessment of Potential Open Pit Groundwater Inflows, Beaver Dam Gold Project, Nova Scotia.

Phillips, R. L., Berg, W. E., & Siniff, D. B. (1973). Moose Movement Patterns and Range Use in Northwestern Minnesota. *The Journal of Wildlife Management*, *37*(3), 266-278.

Pietz, P. J., & Tester, J. R. (1982). Habitat Selection by Sympatric Spruce and Ruffed Grouse in North Central Minnesota. The Journal of Wildlife Management, 46(2), 391-403.

Port of Sheet Harbour. 2017. [Online] Retrieved from: http://portofsheetharbour.ca/ (Accessed February 3rd 2017)

Reed, A., & G. Moisan. 1971. The Spartina tidal marshes of the St. Lawrence estuary and their importance to aquatic birds. Naturaliste Can. 98: 905-922.

Reid, S. M., Yunker, G. & Jones, N. E. (2009). Evaluation of single-pass backpack electric fishing for stream fish community monitoring. *Fisheries Management and Ecology*, *16*(1), 1-9. doi:10.1111/j.1365-2400.2008.00608.x

Resource Capital Gold Corp. 2017. Retrieved from: http://www.rcgcorp.ca/projects/tangier. (Accessed February 2017).

RBC 2016: Royal Bank of Canada, Provincial Outlook – Nova Scotia p.9, December 2016. Retrieved from http://www.rbc.com/newsroom/_assets-custom/pdf/20161216-provfcst.pdf#page=9

Roland, A. E. (1998). *Roland's Flora of Nova Scotia* (Vols 1-2). Nova Scotia: Nova Scotia Museum and Nimbus Publishing.

Saskatchewan Ministry of Environment. 2015. Common Nighthawk Survey Protocol. Fish and Wildlife Branch Technical Report No. 2015-15.0. 3211 Albert Street, Regina Saskatchewan. 7 pp.

Seymour, N. R. (1984). Activity of black ducks nesting along streams in northeastern Nova Scotia. *Wildfowl 35,*143-150.

Shank, C. C., 1979. Human-related behavioural disturbance to northern large mammals: A bibliography and review. Report prepared for Foothills Pipe Lines (South Yukon) Ltd., Calgary.

Siegela, D. I. (1988). The Recharge-Discharge Function of Wetlands near Juneau, Alaska: Part I. Hydrogeological Investigations. *Groundwater*, *26*(4), 427-434. doi:10.1111/j.1745-6584.1988.tb00408.x.

Smith P. K. and Kontak D. J. 1996: Gold Deposits in the Meguma Group of Nova Scotia. Department of Natural Resources, Minerals and Energy Branch, Information Circular 51.

Snaith, T. V., and Beazley, K. F. 2004. The distribution, status, and habitat associations of moose in mainland Nova Scotia. *Proceedings of the Nova Scotian Institute of Science*, *42(*2), 263-317.

Snaith, T. V., Beazley, K. F., MacKinnon, F., & Duinker, P. (2002). Preliminary Habitat Suitability Analysis for Moose in Mainland Nova Scotia, Canada. *Alces*, *38*.

Soil & Water Conservation Society of Metro Halifax. (2016). Brook Trout *Salvelinus fontinalis*. Retrieved from http://lakes.chebucto.org/WATERSHEDS/FISHERIES/FISHES/TROUT/BROOK_TROUT/brook_trout.html

Sooley, D. R., Luiker, E. A., Barnes, M. A., & Canada. (1998). *Standard methods guide for freshwater fish and fish habitat surveys in Newfoundland and Labrador: rivers & streams*. St. John's NL: Department of Fisheries and Oceans, Science Branch.

Statistics Canada, 2017: *Beaver Lake 17, IRI [Census subdivision], Nova Scotia and Nova Scotia [Province]* (table). *Census Profile*. 2016 Census. Statistics Canada Catalogue no. 98-316-X2016001. Ottawa. Released February 8, 2017. http://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E (Accessed March 2017).

Statistics Canada. 2017a: *Sheet Harbour 36, IRI [Census subdivision], Nova Scotia and Halifax, CTY [Census division], Nova Scotia* (table). *Census Profile*. 2016 Census. Statistics

Canada Catalogue no. 98-316-X2016001. Ottawa. Released February 8, 2017. http://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E (accessed March 2017).

Stea, R.R., Conley, H., and Brown, Y. 1992. Surficial Geology of the Province of Nova Scotia. Map 92-3, 1:500,000 scale. Nova Scotia Department of Natural Resources.

Stewart, R. L. M., K. A. Bredin, A. R. Couturier, A. G. Horn, D. Lepage, S. Makepeace, P. D. Taylor, M.-A. Villard, and R. M. Whittam (eds). 2015. Second Atlas of Breeding Birds of the Maritime Provinces. Bird Studies Canada, Environment Canada, Natural History Society of Prince Edward Island, Nature New Brunswick, New Brunswick Department of Natural Resources, Nova Scotia Bird Society, Nova Scotia Department of Natural Resources, and Prince Edward Island Department of Agriculture and Forestry, Sackville, 528 + 28 pp.

The Stream Steward. (n.d.). Trout Habitat Enhancement. Retrieved from https://www.ofah.org/streamsteward/files/Resources/Trout%20Habitat%20Enhancement.pdf

Sweeney, B. W., & Schnack, J. A. (1977). Egg development, growth, and metabolism of Sigara alternata (Say) (Hemiptera: Corixidae) in fluctuating thermal environments. *Ecology, 58*(2), 265-277.

Takats, D. L., C. M. Francis, G. L. Holroyd, J. R. Duncan, K. M. Mazur, R. J. Cannings, W. Harris, D. Holt. 2001. Guidelines for Nocturnal Owl Monitoring in North America. Beaverhill Bird Observatory and Bird Studies Canada, Edmonton, Alberta. 32 pp.

Taylor Lumber. 2017. [Online] Retrieved from: http://www.taylorlumber.ca (Accessed February 3rd 2017)

Telfer, E. S. 1967a. Comparison of moose and deer range in Nova Scotia. *Journal of Wildlife Manegement*, *31*, 418-425.

Telfer, E. S. 1967b. Comparison of a deer yard and a moose yard in Nova Scotia. *Canadian Journal of Zoology 45*, 485-490.

Thomsen, A. G., & Friberg, N. (2002). Growth and emergence of the stonefly Leuctra nigra in coniferous forest streams with contrasting pH. *Freshwater Biology*, *47*(6), 1159-1172.

Twomey, K. A., K. L. Williamson, and P. C. Nelson. 1984. Habitat suitability index models and instream flow suitability curves: White sucker. U.S. Fish Wildl. Serv. FWS/OBS-82/10.64. 56 pp.

Underhill, J.E., and Angold, P.G. 2000. Effects of roads on wildlife in an intensively modified landscape. Environ. Rev. 8:21-39.

United Nations. 2014. Framework Convention on Climate Change, National Inventory Submissions 2016. Retrieved from: http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/9492.php (Accessed January 2017)

United States Army Corps of Engineers. 2011. *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (Version 2.0)*, ed. J. S. Wakeley, R. W. Lichvar, C. V. Noble, and J. F. Berkowitz. ERDC/EL TR-12-1. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

United States Department of Agriculture & Natural Resources Conservation Service, Soil Survey Staff. (2003). *Keys to Soil Taxonomy* (9th Ed.). Retrieved from https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051544.pdf

Van Ballenberghe, V., & Peek, J. M. (1971). Radiotelemetry Studies of Moose in Northeastern Minnesota. *The Journal of Wildlife Management*, *35*(1), 63-71.

Vannote, R. L., & Sweeney, B. W. (1980). Geographic analysis of thermal equilibria: A conceptual model for evaluating the effect of natural and modified thermal regimes on aquatic insect communities. *American Naturalist*, *115*(5), 667-695.

Weber-Scannell, P. K., & Duffy, L. K.. (2007). Effects of Total Dissolved Solids on Aquatic Organisms: A Review of Literature and Recommendation for Salmonid Species. American Journal of Environmental Sciences, 3(1), 1-6.

Wilton, M. L. & D. L. Garner. (1991). Preliminary findings regarding elevation as a major factor in moose calving site selection in South Central Ontario, Canada. *Alces*, *27* 111–117.

With, K. A., & Crist, T. O. (1995). Critical Thresholds in Species' Responses to Landscape Structure. *Ecology*, *76*(8), 2446-2459. doi:10.2307/2265819

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

Yuan, L. L. (2004). Assigning macroinvertebrate tolerance classifications using generalized additive models. *Freshwater Biology*, *49*(5), 662-677.