Touquoy Gold Project Modifications – Environmental Assessment Registration Document

July 2021
File: 121619250

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SD 01 Environmental Protection Plan

SD 02 Erosion and Sediment Control Plan - Updated

SD 03 Groundwater Contingency Plan Revision 1.2

SD 04 ML/ARD Management Plan

SD 05 Water Management Plan Version 1.0

SD 06 Reclamation Plan

SD 07 Wetland Protection Plan

SD 08 Wildlife Management Plan

SD 09 Monitoring of the Effects of Sediment Deposition in Wetlands 6 and 15, Year 1 (2020)

SD 10 2017 Baseline Aquatic Environmental Technical Report

SD 11 2018 Supplemental Baseline Aquatic Environmental Technical Report

SD 12 Study Design for the Phase 1 Environmental Effects Monitoring Program

SD 13 Supplemental Fish Tissue Study

SD 14 Assessment of Wetlands 6 and 15 and Watercourse 4

SD 15 Fish Habitat Assessment Survey in Moose River in the Vicinity of the Proposed Pit Expansion

SD 16 Fish Habitat Assessment in Moose River in the Vicinity of the Existing Open Pit

SD 17 Scraggy Lake – Withdrawal Rate with Potential Dam Breach Considerations

SD 18 Study Area Extension (Square Lake) Wetland and Watercourse Delineation

SD 19 2020 Annual Report - Final with Appendices

SD 19A 2020 Annual Report - Surface Water and Groundwater Monitoring

SD 20 2019 Post-construction Wetland Monitoring Report

SD 21 Evaluation of Potential for Aquatic Effects

SD 22 Emergency Response Plan AGC-PLN-HS-001 (2020)

SD 23 Geotechnical Investigation – Waste Rock Storage Area Drainage Ditches – Phase 3

SD 24 Response to Information Requests for Fisheries and Oceans Canada (Reference 20-HMAR-00531; October 9, 2020)

Executive Summary

The Touquoy Gold Project (also referred to as the Approved Project) is an open pit gold mine operated by Atlantic Mining NS Inc (AMNS) under Industrial Approval (IA) No. 2012-0824244-08. AMNS is a wholly owned subsidiary of the Australian-based St. Barbara Limited.

The Touquoy Gold Project is located in Moose River, Nova Scotia, approximately 63 km northeast of Halifax and 19 km southeast of Middle Musquodoboit. The Touquoy Gold Project started mining operations in 2017 and attained commercial production in March 2018, with an estimated life of four to six years.

Project Overview

AMNS is proposing modifications to the Approved Project that are required to support ongoing operations. These modifications are listed below and represent the Project to be assessed in this Environmental Assessment Registration Document (EARD):

- use of the exhausted Open Pit for tailings disposal instead of the existing approved Tailings Management Facility (TMF)
- expansion of the Waste Rock Storage Area (WRSA)
- expansion of the Clay Borrow Area
- relocation of the road used to access the Mill Plant

Currently, tailings from the processing of ore are deposited in the TMF. However, the TMF is expected to reach its capacity for tailings in March 2022. The Open Pit is anticipated to be exhausted in 2022. AMNS is proposing to use the exhausted Open Pit for tailings disposal when the TMF reaches its design capacity. Once the Open Pit has been exhausted, it will be allowed to fill with groundwater, surface runoff and precipitation, creating the necessary conditions for tailings disposal. When the water level in the pit reach an elevation of 108 m, water will start to seep out to Moose River. The pit lake will be treated as a batch reactor with the objective of adjusting the pH to precipitate metals thus improving discharge quality. Water quality monitoring will determine if the surplus water can be directly discharged to Moose River via a constructed spillway or whether the surplus water must be pumped first to a treatment facility before it is suitable for discharge to the environment.

The WRSA is used to store waste rock and low/medium grade ore. The current WRSA reached its capacity early in 2021 and AMNS is temporarily storing waste rock in the Open Pit. To increase capacity, maintain stable height requirements, and accommodate future growth, the proposed WRSA expansion is approximately 7.1 ha (increasing the total footprint of the WRSA to 42.1 ha) which will create an additional 2.5 million cubic metres (Mm^3) of capacity. The WRSA expansion will require alteration of wetland habitat and construction of additional water management structures to collect, convey, and/or treat (e.g., sedimentation) surface water runoff and shallow seepage from the WRSA. This expansion of the WRSA will also require the relocation of the Plant Access Road to the west of the site, as well as the relocation of a groundwater monitoring well currently located within the proposed development area. The

Plant Access Road will be approximately 1,278 m long and approximately 14.6 m wide. The proposed route for the relocated Plant Access Road has been designed to avoid sensitive environmental features (i.e., wetlands, watercourses, rare plants). The proposed Plant Access Road will relocate existing Mine Site traffic, will improve safety, and will not result in an overall increase in mine traffic.

Clay is used at the Touquoy Mine Site for various construction and maintenance requirements. The construction of the Plant Access Road, and the WRSA expansion will require more clay than what is currently available from the approved sources. Therefore, the Project includes a proposed expansion (approximately 5.9 ha) of the existing Clay Borrow Area. Construction vehicles and machinery associated with the Project activities will generate air emissions (including greenhouse gases and dust) and noise emissions. These emissions will be localized, temporary, managed in accordance with existing management plans and IA conditions.

Pending regulatory approval to proceed, construction will begin as soon as possible on the Plant Access Road and expansion of the WRSA and Clay Borrow Area. In-pit tailings disposal is expected to start in July 2022, based on the expected capacity of the existing TMF and anticipated end of mining from the Open Pit. Closure of the WRSA will likely begin in 2022. The Clay Borrow Area and Plant Access Road will remain in operation as needed to support mine closure activities.

Engagement

AMNS recognizes that effective communication and engagement with Indigenous communities, the public, stakeholders, and regulatory agencies is a key component of a successful project and an effective environmental assessment. AMNS has engaged directly with the Mi’kmaq of Nova Scotia through dialogue with the Kwilmu’kw Maw-Klusuaqn Negotiation Office (KMKNO) and First Nation communities in proximity to the Touquoy Mine Site. AMNS continues to engage directly with the Millbrook First Nation and is continuing efforts to open a dialogue with the Sipekne’katik First Nation. Both First Nations represent themselves in consultation and negotiation matters outside the KMKNO process. AMNS has also had a community liaison committee (CLC) in place since 2011, and has undertaken One-Window meetings with provincial and federal regulators. AMNS has communicated with the Mi’kmaq of Nova Scotia, the CLC and provincial and federal regulators about the proposed modifications to the Approved Project, and will address and respond to additional stakeholders identified or issues noted as the Project moves through the EA process and proceeds to implementation.

Summary of Environmental Effects Assessment

This EARD has been prepared to assess the environmental effects of proposed Project modifications and activities. Based on an understanding of potential environmental interactions, mitigation measures have been proposed to reduce the likelihood and magnitude of potential adverse effects that could arise from these potential interactions. Residual effects (i.e., after mitigation has been applied) of the Project are analyzed and characterized. Where there may be data gaps or some uncertainty around a predicted effect, or the effectiveness of proposed mitigation, follow-up and monitoring is described.

The EARD focuses on the following Valued Components (VCs):

- Groundwater Resources
- Surface Water Resources
- Fish and Fish Habitat
- Terrestrial Environment
- Cultural and Heritage Resources

Project activities have the potential to affect groundwater quantity and quality as a result of changes to groundwater recharge, level, and flow. Groundwater modelling has been conducted to predict groundwater flows and water quality. Groundwater drawdowns will not result in changes to well yields at existing or future groundwater users, and the Project will not result in groundwater quality that exceeds the GCDWQ for a period of 30 days or more at existing or future groundwater users located outside of the PDA. Because of this, residual effects of the Project on groundwater resources are predicted to be not significant. The Environmental Effects Monitoring (EEM) program for the Approved Project will be updated to confirm predictions in changes to water quantity and quality.

Project activities may affect surface water quantity and quality through changes in water catchment areas and surface water runoff. Modelling has been conducted to predict surface water flows, and changes in water quality as a result of the Project. With the installation of water management features to divert and/or treat surface water flow, residual effects of the Project on surface water resources are predicted to be not significant. The EEM program for the Approved Project will be updated to monitor the effectiveness of proposed water management features and to confirm water quantity and quality predictions.

Project activities may also result in changes in fish habitat quantity, fish habitat quality, and fish health and survival. Potential reductions in fish habitat quantity and quality associated with Project-related changes in watershed area and streamflow, groundwater seepage, and effluent discharges will be mitigated through the installation of various water management features. Changes in water quality will be monitored and water will be treated as required to avoid or reduce adverse effects on fish habitat quality. Effluent discharges are not expected to result in direct mortality or sublethal effects to fish. Although some changes in fish habitat quality are predicted within localized reaches of watercourses and waterbodies associated with the Touquoy Mine Site, no measurable effects are predicted further downstream or within the Ship Harbour Wilderness Area. Potential effects to fish and fish habitat will be assessed by ongoing EEM programs. With careful Project planning, design, mitigation and adaptive management as required, changes to the productivity or sustainability of fish populations is not predicted and Project-related effects on fish and fish habitat are predicted to be not significant.

Expansion of the WRSA and Clay Borrow Area and construction of the Plant Access Road will result in approximately 17.68 ha of direct impact to upland and wetland habitats, approximately 0.98 ha of which is attributed to direct wetland impacts. As a result of this habitat loss, there is predicted loss of lichen species of conservation interest, although no lichen species at risk. The Project will also result in small additional loss of habitat for hare, mainland moose and passerine bird species. However, much of the impacted habitat has been previously disturbed, is not high quality, and is common throughout the Eastern Interior Ecodistrict. Wildlife may be affected due to sensory disturbances associated with noise and light emissions, dust emissions and risk of mortality due to vehicle collisions, however, these indirect effects to wildlife are not expected to increase beyond those associated with the current operations of the Touquoy Mine Site.

AMNS will obtain regulatory approval prior to any construction in a wetland and will work with Nova Scotia Environment and Climate Change (NSECC) to develop the required mitigation measures including wetland compensation to mitigate any loss of wetland habitat. Direct impacts to priority lichen will be mitigated through species collection prior to development and indirect impacts to priority lichen will be monitored through the proposed Lichen Monitoring Plan. With careful Project planning, design, mitigation and compensation as required, Project-related effects on the terrestrial environment are predicted to be not significant.

Since 2006, the Touquoy Mine Site has been subject to several archaeological resource impact assessments (ARIAs), including one conducted in 2021 focusing on new areas that were previously unassessed and that will be affected by the proposed WRSA and Clay Borrow Area expansions. The Touquoy Mine Site is determined to have low archaeological potential. AMNS has committed to maintaining buffer zones around Moose River and Square Lake and conducting future ARIAs should further changes to the layout of the Touquoy Mine Site occur outside study areas previously assessed for archaeological potential. In consultation with provincial government and the Mi’kmaq of Nova Scotia, AMNS has also prepared a contingency plan to be implemented in the event that an archaeological site is encountered or suspected during the course of work.

In consideration of the proposed modifications to the Approved Project the following specific accidents and malfunctions have been assessed in the EARD:

- WRSA slope failure
- Failure of water management infrastructure
- Tailings line failure
- Fuel and hazardous materials spill

Although the magnitude of effects of these accidents and malfunctions could vary depending on several variables (e.g., severity of break/failure, seasonal timing, location, and proximity to sensitive receptors), overall, in consideration of compliance with engineering design standards, ongoing inspection, emergency response procedures, and if, required, environmental remediation, significant adverse effects are not likely to occur as a result of these potential accidents and malfunctions.

Conclusion

Potential adverse effects of the Project on groundwater resources, surface water resources, fish and fish habitat, terrestrial resources, and cultural and heritage resources will be avoided or reduced through regulatory compliance, adherence to existing management plans for the Approved Project, implementation of best management practices, and implementation of site-specific design features. Existing contingency and emergency response plans for the Approved Project will be implemented to reduce risk and consequences of accidental events and malfunctions.

Residual effects of routine Project activities are predicted to be not significant. The magnitude of effects of accidental events or malfunctions could vary, however in consideration of compliance with engineering design standards, ongoing inspection, emergency response procedures, and if, required, environmental remediation, significant adverse effects are not likely to occur.

Ongoing monitoring programs for groundwater, surface water, fish and fish habitat, and wetlands will continue and be modified as necessary to capture changes to the site layout and activities as a result of the Project. These monitoring programs will confirm regulatory compliance and effectiveness of mitigation measures, as well as help identify the need for additional mitigation and adaptive management at the Touquoy Mine Site.

Acronyms and Abbreviations

ABA	Acid Based Accounting
AMNS	Atlantic Mining NS Inc.
ARD	Acid Rock Drainage
ARIA	Archaeological Resource Impact Assessment
AS	Arsenic
AQM	Air Quality Management
BAP	Best Available Practice
CCME	Canadian Council of Ministers of the Environment
CCME CWQGC FAL	Canadian Council of Ministers of the Environment Water Quality Guidelines – Freshwater Aquatic Life
CEQG	Canadian Environmental Quality Guidelines
CGVD	Canadian Geodetic Vertical Datum
CLC	Community Liaison Committee
CMM	Confederacy of Mainland Mi'kmaq
CNFD	Canadian National Fire Database
CNt	Total Cyanide
COPC	Contaminants of Potential Concern
COSEWIC	Committee on the Status of Endangered Wildlife In Canada
CRA	Conestoga Rover and Associates
CU	Copper
DBL	Decibel
DFO	Department of Fisheries and Oceans
DO	Dissolved Oxygen

EA	Environmental Assessment
EARD	Environmental Assessment Registration Document
ECCC	Environment and Climate Change Canada
EEM	Environmental Effects Monitoring
EMP	Environmental Management Plan
EMS	Environmental Management System
EPP	Environmental Protection Plan
ESCP	Erosion and Sediment Control Plan
ETP	Effluent Treatment Plan
GCDWQ	Guidelines for Canadian Drinking Water
GWCP	Groundwater Contingency Plan
GHG	Greenhouse Gas
HA	Hectare
HADD	Harmful Alteration or Destruction of Fish Habitat
HTC	Historic Tailings Containment Cell
IA	Industrial Approval
IH	Intolerant Hardwood
ISQGS	Interim Sediment Quality Guidelines
ITRB	Independent Tailings Review Board
KMKNO	Kwilmu'kw Maw-Klusuaqn Negotiation Office
KMKNO-ARD	Kwilmu'kw Maw-Klusuaqn Negotiation Office – Archaeological Research Division
Km^2	Square Kilometer
Km/h	Kilometers Per Hour
LAA	Local Assessment Area

L/S	Litres Per Second
M^3/d	Cubic Metres Per Day
MAC	Maximum Acceptable Concentrations
MAF	Mean Annual Flow
MAMMC	Maximum Authorized Mean Monthly Concentration
MASL	Metres Above Sea Level
MDMER	Metal and Diamond Mining Effluent Regulations
Mg/L	Milligrams Per Liter
MBCA	Migratory Birds Convention Act
MKS	Mi’kmaq Knowledge Study
ML/ARD	Metal Leaching / Acid Rock Drainage
MLA	Member of Legislative Assembly
MMMP	Mainland Moose Management Plan
mm	Millimeter
MMF	Mean Monthly Flow
m/s	Metres Per Second
NBCC	National Building Code of Canada
NPR	Net Potential Ratio
NP	Neutralizing Potential
NS DEM	Nova Scotia Department of Energy and Mines
NSECC	Nova Scotia Department of Environment and Climate Change
NSESA	Nova Scotia Endangered Species Act
NSLF	Nova Scotia Lands and Forest
NI	Nickel
NSOLA	Nova Scotia Office of L’nu Affairs

NTU	Turbidity
OMS	Operation Maintenance and Surveillance Manual
OPM	Open it Mine Series Wells
OPRP	Operational Preparedness and Response Plan
PAG	Potentially Acid Generating
PEL	Probable Effects Levels
PDA	Project Development Area
PG	Peatland Group
PLM	Plant Series Wells
PM	Particulate Matter
POPC	Parameters of Primary Concern
R^2	Regression Coefficient
RAA	Regional Assessment Area
RoW	Right of Way
SAD	Strong Acid Dissociable
SAR	Species at Risk
SARA	Species at Risk Act
SFE	Shake Flash Extraction
SH	Spruce Hemlock
SOCC	Species of Conservation Concern
SOCI	Species of Conservation Interest
SP	Spruce Pine
SSWQ	Site Specific Water Quality Objective
SW	Surface Water
T/m^3	Tonnes Per Cubic Metre

TMF	Tailings Management Facility
TPD	Tonnes Per Day
TMF EPRP	Tailings Management Facility Emergency Preparedness and Response Plan
TMW	Tailings Management Wells
TSD	Technical Supporting Document
TSP	Total Suspended Particulate
TSS	Total Suspended Solids
µg/L	Micrograms Per Liter
UNSM	Union of Nova Scotia Mi'kmaq
VC	Valued Component
WAD	Weak Acid Dissociable
WC	Wet Coniferous
WMP	Wildlife Management Plan
WRSA	Waste Rock Storage Area
WRW	Waste Rock Well
WSC	Water Survey of Canada
WSS	Wetland of Special Significance
ZN	Zinc

1.0 INTRODUCTION

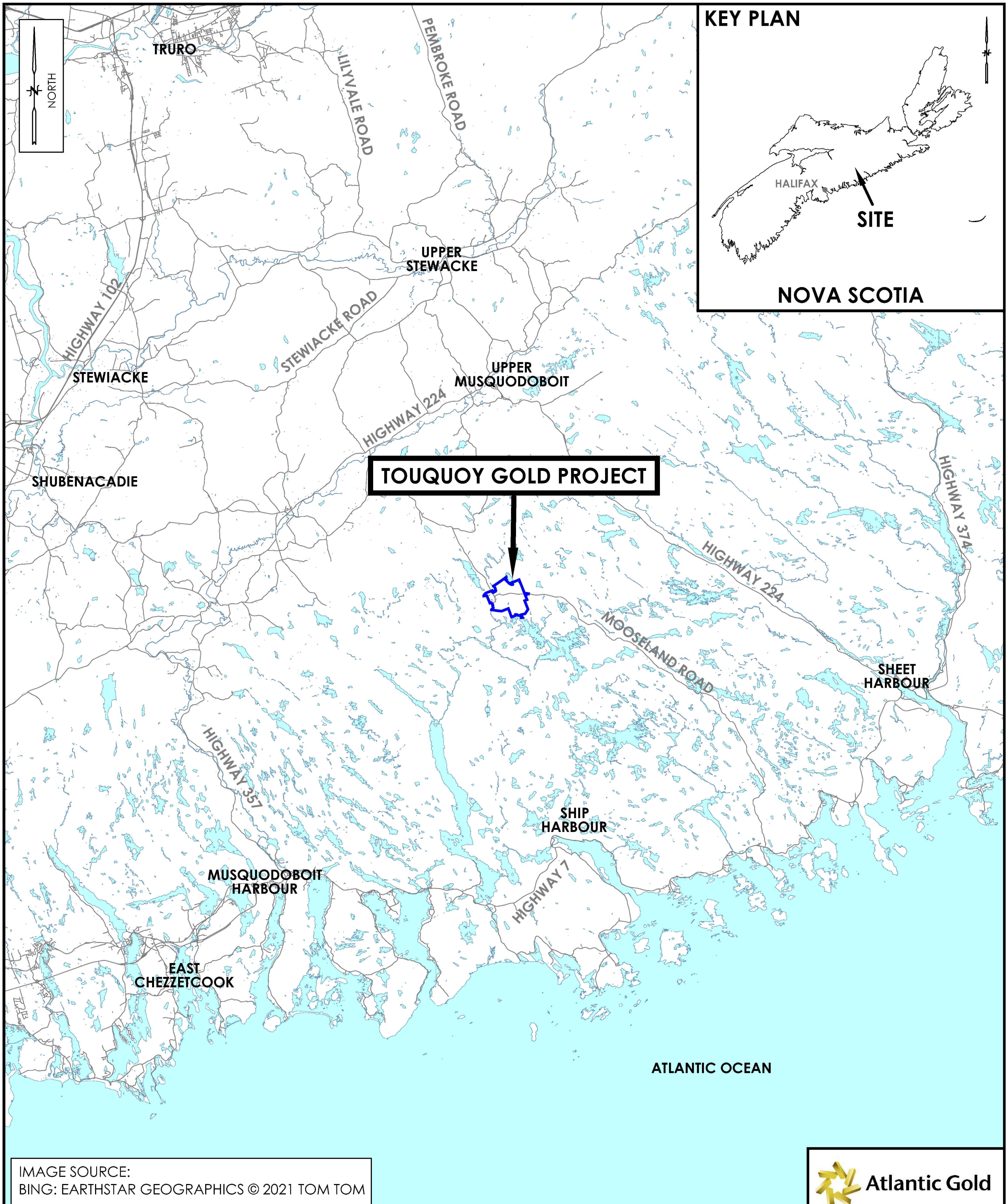
The Touquoy Gold Project (the Approved Project) is an open pit gold mine operated by Atlantic Mining NS Inc (AMNS) under Industrial Approval (IA) No. 2012-0824244-08. The Mine Site is located in Moose River, Nova Scotia, approximately 63 km northeast of Halifax and 19 km southeast of Middle Musquodoboit (Figure 1.1). Production for the Touquoy Gold Project is estimated at 8,400 tonnes of ore per day (tpd) with an anticipated total ore production of 9.35 million tonnes for the recovery of 0.4 million ounces (oz) of gold. The Touquoy Gold Project started the mining operation in October 2017 and attained commercial production in March 2018.

AMNS is proposing modifications to the Approved Project to support the ongoing operation. These modifications include: use of the exhausted Open Pit for tailings disposal instead of the existing approved Tailings Management Facility (TMF); expansion of the Waste Rock Storage Area (WRSA); expansion of the Clay Borrow Area; and realignment of the Plant Access Road used to access the Plant Site. These proposed modifications will increase the current approved development area, or, in the case of the in-pit tailings disposal, present a new activity not previously assessed in the original Environmental Assessment (EA) process for the Touquoy Gold Project conducted in 2007 (CRA 2007a, 2007b).

Upon review of these proposed modifications to the Approved Project, the Minister of Environment has determined that a Class I EA) registration under the *Environment Act* and Environmental Assessment Regulations is required. This environmental assessment registration document (EARD) has been prepared to evaluate the impacts of these proposed modifications and satisfy requirements of a Registration of a Class I Undertaking under the Environmental Assessment Regulations.

1.1 PROPONENT INFORMATION

The proponent is Atlantic Mining NS Corp (AMNS), a wholly owned subsidiary of the Australian based St. Barbara Limited. In addition to the Touquoy Gold Project, AMNS holds three other gold development projects in Nova Scotia which are at various stages of planning and regulatory review. These are the Beaver Dam Mine Project and Fifteen Mile Stream Gold Project, both of which are currently undergoing federal and provincial environmental assessment review, and the Cochrane Hill Gold Project (assessment and permitting to be undertaken in the future).



Atlantic Gold

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SITE LOCATION

TOUQUOY GOLD PROJECT
HALIFAX COUNTY, NOVA SCOTIA

Job No.:	121619250
Scale:	1 : 400,000
Date:	06-JUL-2021
Dwn. By:	JL
App'd By:	SW
Fig. No.:	1.1
Client:	ATLANTIC MINING NS INC.

Stantec

V:\1216\active\121619250\1_geotechnical\3_drawings_logs\2500_TOUQUOY\4_Sheet_Files\12_TASK-2600-EA\121619250.2600_EA_F1.1_REV0.dwg

Project Name: Touquoy Gold Project Modifications

Proponent Contact Information:

Corporate Contact	**EA Contact**
Atlantic Mining NS Inc. 409 Billybell Way RR#2 Middle Musquodoboit, NS B0N 1X0	Atlantic Mining NS Inc. 409 Billybell Way RR#2 Middle Musquodoboit, NS B0N 1X0
Andrew Taylor General Manager Atlantic Operations (902) 384-3603 Email: andrew.taylor@atlanticgold.ca	Craig Hudson Head of Permitting and Projects (902) 384-3641 Email: craig.hudson@atlanticgold.ca

Signature of Authority	Signature of Authority
	CHudson
Date: July 7, 2021	Date: July 7, 2021

1.2 PROJECT OVERVIEW

For the purpose of this EARD, the Project is defined as specific modifications that are being proposed for the Approved Project. These modifications are:

- in-pit disposal of tailings
- expansion of the WRSA
- expansion of the Clay Borrow Area
- relocation of the Plant Access Road

With the exception of in-pit disposal of Touquoy tailings, these are not new components for the Approved Project and construction, operation and decommissioning activities associated with these components at the Touquoy Mine have been previously assessed in the EARD for the Touquoy Gold Project (CRA 2007a) and the associated Focus Report (CRA 2007b). The effects assessment presented in this EARD will focus on the modification (e.g., change in footprint) with reference to existing EA documentation and monitoring reports, as applicable.

1.3 BACKGROUND

1.3.1 History of the Touquoy Gold Project

The Touquoy Gold Project is located in an area known for historic gold mining activities. Gold was first discovered in what is now the community of Moose River Gold Mines in 1866 but it was not until 1877 that mining began. From 1877 to the outbreak of the First World War in 1914 an estimated fifteen shafts and eight pits were dug, producing approximately 26,000 oz of gold from roughly 80,000 tonnes of ore.

Immediately following the First World War no known attempts were made to mine for gold at the Touquoy site. However, by 1935 renewed efforts led to the development of an open shaft, which ultimately collapsed trapping several miners below ground. The subsequent rescue efforts became a highly publicized event both in Canada and abroad.

Following the mine collapse and rescue of 1935-36, interest waned in the Touquoy property until 1983 when Seabright Explorations Inc. expressed interest in the property and commenced exploratory drilling activities. In 1987 Westminster Resources Ltd. took over ownership of Seabright and continued the drilling program. By the end of 1989 Westminster collected a 57,000 tonne bulk sample that was taken from the site and processed by a third party (CRA 2007a).

A further round of drilling was completed in 1996 by Moose River Resources Inc. and by 2003, following multiple changes in ownership, Atlantic Gold NL (then known as Diamond Ventures NL) and its subsidiary DDV Gold Ltd obtained a 60% interest in the Touquoy property.

In the mid-2000s DDV Gold Ltd. began the permitting process for the Touquoy Gold Project. Following submission of the EARD (CRA 2007a) and Focus Report (CRA 2007b), the Minister of Environment and Labour released the Touquoy Gold Project from the EA process in February 2008 allowing DDV Gold to begin the subsequent permitting process. An application for an IA was submitted to Nova Scotia Environment and Climate Change (NSECC) in 2012 and approved in 2014 under IA # 2012-084244.

Mining of the Open Pit began in October 2017, with commercial production declared in March 2018. Since October 2017, Atlantic Gold, through a wholly owned subsidiary AMNS, has operated the Touquoy Gold Project. In July 2019, AMNS became a wholly owned subsidiary of St. Barbara Limited.

1.3.2 Summary of Existing Operations for the Approved Project

The Touquoy Gold Project is an open pit gold mine, currently milling an average of 8,400 tpd of ore. The original estimated life of mine was five years, based on a 9.3 Mt mineable reserve with potential to lengthen the life of mine through ongoing mineral exploration activities at the Touquoy Gold Project as well as on the nearby mineral claims if approvals are received (Beaver Dam, Fifteen Mile Stream, Cochrane Hill). The reserve was last updated in March 2019 with the revised estimate at 12.91 Mt. There is also a considerable volume of potential medium and low-grade ore stored at the site in the WRSA that could be processed at the site depending on economic conditions and the status of its environmental approvals.

Ore is mined from the Touquoy Pit (Open Pit) and delivered to the Mill Facility for processing. Processing involves size reduction of the ore by crushing and grinding and recovery of the contained gold by mechanical and chemical processes. Tailings from the Mill Facility are pumped via pipeline to the TMF. Water associated with the Touquoy tailings is recycled for use in processing.

The TMF includes a tailings pond, polishing pond, a constructed wetland, and associated facilities. The tailings pond manages the tailings discharge slurry, water retained in the tailings' voids, historical tailings cells and runoff from the contributing TMF catchment. Mine contact water from the Mill Facility. Open Pit, and WRSA is also directed to the TMF. Collection ditches along the east, west, and north of the tailings pond are designed to collect a shallow seepage from the tailings pond and pump it back into the tailings pond.

Waste rock is generated during Open Pit development and is used during operation for grading and construction of embankments and other infrastructure, assuming it meets set environmental criteria as outlined in the IA and other supporting documents. Waste rock not used for site development is stored permanently in the WRSA, which will be reclaimed at closure. During the development of the site, materials such as topsoil and overburden have been stockpiled at various locations. These materials are to be used for reclamation.

AMNS is committed to developing and operating the Approved Project in accordance with the regulations of the Nova Scotia Department Energy and Mines (NS DEM), NSECC, and other applicable regulatory and industry requirements.

Section 3.0 provides additional information on environmental management of the Approved Project, including current environmental effects and compliance monitoring programs and environmental performance of the Approved Project to date.

1.4 PURPOSE AND NEED FOR THE PROJECT

As a mining operation proceeds, the delineation and understanding of the ore body improves, and enhancements are made to the mine plan in an iterative fashion that supports efficient production. Proposed modifications to the Touquoy Mine Site are needed to support ongoing operation of the Approved Project. Specific details on the purpose and need for each proposed Project component are provided below.

1.4.1 In-pit Tailings Disposal

In-pit tailings is required to address insufficient storage capacity of the existing TMF. Based on tailings deposition modelling completed in 2020, the Touquoy Mine TMF will reach capacity in March 2022. This is an emergent requirement that has been foreseen due to the mineralization ratio and nature of the ore body in which identified minerals are widely distributed across the strata. Materials originally classified as waste rock are also now being considered as potential medium grade ore. These are common occurrences in open pit mining whereby the initial planning is based on geological modelling and the waste-ore cut off limits are further refined as additional data is collected during mining and influenced by fluctuating economic factors. Approximately 22% more tonnes of ore are now being processed to achieve the same number of forecasted ounces of gold, and over twice the quantity of medium grade ore has been identified for processing. These factors have led to an increased tailings ratio. As of July 1, 2020, 3.3 Mm^3 of capacity remained in the TMF.

In December 2020, AMNS submitted an application to NSECC (formerly Nova Scotia Environment) seeking an IA amendment to permit expansion of the TMF. The IA amendment application also included a request to expand the WRSA and Clay Borrow Area. Upon review of the application, NSECC informed AMNS that an EARD would be required to address proposed modifications to the Approved Project. AMNS has since determined that while expansion of the TMF would create an expedient solution for tailings management that would enable mining operation to continue, a longer-term and therefore more viable solution is to permit in-pit tailings disposal.

1.4.2 WRSA Expansion

As originally designed, the WRSA had a storage capacity of 10.8 Mm^3. Since then, the original design capacity of the WRSA has been re-evaluated (reduced) due to the following factors:

- Surface water ponds and drainage infrastructure (e.g., perimeter ditching modifications) were constructed as environmental controls on the site reducing the capacity of the WRSA by approximately 3.3 Mm^3.
- A wetland area (representing 0.7 Mm^3 of storage capacity) was delineated within the planned development area of the WRSA, reducing the available storage area due to geotechnical requirements.

In addition to these spatial reductions, as ore within the Open Pit is classified as either waste, or potential low-grade / medium-grade material, it has been managed by segregation within the WRSA to allow for potential future extraction and processing. This type of waste-ore material management requires additional space.

Based on the current operation, the WRSA is rapidly reaching its capacity. Although AMNS has identified the potential for temporary in-pit storage that will establish an additional three months of waste rock storage space, this alternative solution would require repeat handling of the material and not provide a long-term solution. To re-establish lost capacity, maintain stable height requirements, and accommodate future growth, the WRSA requires an additional 2.5 Mm^3 of capacity.

The expansion of the WRSA will necessitate the relocation of the Plant Access Road to the west of the site, as well as the relocation of groundwater monitoring wells WRW-1A/B.

1.4.3 Clay Borrow Area

Clay is used at the Touquoy Mine Site for various needs including construction of the TMF dam clay core, and construction and maintenance of ditching for surface water, seepage, and runoff management. Use of the current approved borrow area over time has revealed sub-standard clay material (e.g., notable increase in sand, gravel, and cobble content of the soil). The clay in these areas of the borrow area has failed geotechnical suitability testing for construction, resulting in delays in site works, due to the hauling and removal of unsuitable material. This led AMNS to pursue alternative clay borrow sources including an off-site third-party source, along with extensions to the existing approved Clay Borrow Area.

Clay in the southeastern portion of the borrow area, following the centerline of the drumlin, has been of acceptable quality thus far but reliance on this area has brought AMNS to its currently approved boundary limit again. Therefore, AMNS is requesting to extend the current Clay Borrow Area along the centerline of the drumlin further to the southeast, adding approximately 5.9 ha to the existing approved Clay Borrow Area. This expansion of the Clay Borrow Area will allow AMNS to sustain future operation and on-site construction activity, including construction of the new Plant Access Road and WRSA expansion.

1.4.4 Relocation of the Plant Access Road

The expansion of the WRSA will necessitate the relocation of the existing Plant Access Road which currently runs north of the WRSA within the area of the WRSA expansion. By relocating the Plant Access Road to the west, it will retain access to the Plant Site while increasing site safety by reducing traffic crossing the primary haul road.

1.5 REGULATORY OVERVIEW

The Touquoy Gold Project was approved under the Nova Scotia Environmental Assessment Regulations and is operating under IA #2012-084244-08. This section describes the legislative framework which is applicable to the Approved Project and proposed Project, lists the existing permits for the Approved Project, and indicates the approvals (including amendments to exiting approvals) which will be required to permit proposed Project activities (i.e., approve modifications to the Approved Project).

1.5.1 Legislative Framework

Both provincial and federal acts and regulations govern the design, expansion, site preparation, operation, and reclamation of the Touquoy Gold Project. In addition to provincial and federal environmental legislation, other acts and regulations pertaining to safe work and labor standards as well as mining practices are all applicable to the Touquoy Gold Project (current and proposed).

Table 1.1 summarizes key applicable environmental legislation.

Table 1.1 Key Applicable Federal and Provincial Legislation

Legislation	Relevance	Regulatory Authority
Federal		
Fisheries Act	The *Fisheries Act* contains provisions for the protection of fish, shellfish, crustaceans, marine mammals, and their habitats. Section 35 of the Act pertains to the alteration, disruption, or destruction of fish habitat. Section 36 of the Act pertains to the prohibition of the deposition of a deleterious substance into waters frequented by fish. Authorization under the Act may be required due to physical activities in wetlands, watercourses, and water bodies. The Metal and Diamond Mining Effluent Regulations (MDMER) under the Act require environmental effects monitoring (EEM) due to mining effluent discharge to aquatic habitat. However, the Project is not expected to impact, or overprint waters frequented by fish, as all modifications have been designed to avoid waterbodies including 30 m buffers.	DFO ECCC (MDMER)
Migratory Birds Convention Act, 1994 (MBCA)	Under the MBCA, it is illegal to kill migratory bird species not listed as game birds or destroy their eggs or young. The Act also prohibits the deposit of oil, oil wastes or any other substance harmful to migratory birds in any waters or area frequented by migratory birds. The Act and the associated regulations also prohibit the disturbance of migratory birds.	ECCC-Canadian Wildlife Service
Species at Risk Act (SARA)	SARA is intended to protect species at risk in Canada and their “critical habitat” (as defined by SARA). Section 32 of the Act prohibits the killing, harming, harassment, capture or take of an individual of a wildlife species that is listed as an extirpated species, endangered species, or threatened species. Under s.79 of the Act, proponents are required to complete an assessment of the environment and demonstrate that no harm will occur to listed species, their residences or critical habitat, or identify adverse effects on specific listed wildlife species and their critical habitat, followed by the identification of mitigation measures to avoid or reduce environmental effects. In some cases, a SARA permit may be issued for activities that would otherwise be prohibited under the Act, provided certain conditions are met.	DFO/ECCC/Parks Canada
Provincial		
Environment Act - Environmental Assessment Regulations	The Minister has determined the Project represents a modification to an undertaking that involves the construction, operation, decommissioning of a facility that extracts of processes metallic or non-metallic minerals. As such, the Project is a Class I Undertaking requiring registration under the Act.	NS Environment and Climate Change (formerly NSE)

Table 1.1 Key Applicable Federal and Provincial Legislation

Legislation	Relevance	Regulatory Authority
Environment Act - Activities Designation Regulations	An IA is required for the construction, operation, or reclamation of a surface mine using explosives and procuring mineral bearing ore. The Project will require an amendment to the existing IA approval (IA#2012-084244-08) for the Touquoy Gold Project. Water approval and/or notification will be required for water withdrawal, alteration of water bodies, watercourses, and/or wetlands.	NS Environment and Climate Change
Mineral Resources Act	Act regulates and administers mineral rights, mineral leasing, reclamation and bonding of exploration and mining operation and collection of royalties.	NS Energy and Mines
Special Places Protection Act	Act provides for the preservation, protection, regulation, exploration, excavation, acquisition and study of archaeological and historical remains, paleontological sites, and ecological sites which are considered important parts of the natural and/or human heritage of the Province. A Heritage Research Permit would be required if archaeological work is conducted for the Project.	NS Communities, Culture and Heritage
Wildlife Act	Act prohibits taking, hunting, killing, or possessing eagles, osprey, falcons, hawks, owls, and any other protected wildlife.	NS Lands and Forestry
Endangered Species Act	Act prohibits killing, injuring, disturbing, taking or interfering with endangered or threatened species and/or their habitat.	NS Lands and Forestry
Public Highways Act	Act applies to all highways within the Province not included within the boundaries of a city or town or owned by a municipality. Any planned activity/work on the roadway or within the highway right-of-way requires a Work within the Highway Right-of-Way Permit. The Relocation of the Plant Access Road will require a permit under the Act.	NS Transportation and Active Transport

In addition to legislative requirements, there are numerous guidelines, standards and codes of practice which apply to the Project. These are referenced as applicable throughout the EARD, particularly where they may influence the characterization and/or mitigation of environmental effects.

1.5.2 Regulatory Approval of the Touquoy Gold Project

An EARD was submitted by DDV Gold Ltd to NSE for the Touquoy Gold Project on March 15, 2007 (CRA 2007a). During the review process, a Focus Report was requested by the Minister of Environment and Labour to provide additional detail. A Focus Report was submitted on November 19, 2007 (CRA 2007b) and on February 1, 2008, the Touquoy Gold Project was approved by the Minister of Environment and Labour with conditions. Following this approval, DDV Gold Ltd. began seeking the necessary approvals under the Activities Designation Regulations to construct and operate the mine. Table 1.2 lists the active approvals for the Touquoy Gold Project.

Table 1.2 Active Touquoy Gold Project Approvals (as of March 2021)

Permit ID	Type of Permit	Regulatory Agency	Effective Date	Expiry
Active Approvals				
-	Environmental Assessment Approval	NSECC	01-Feb-2008	Not Applicable
2012-084244-08	Industrial Approval	NSECC	04-Nov-2020	28-Mar-2024
2794371	Crown Land Lease Agreement	NS Lands and Forestry	10-Feb-2016	07-Feb-2026
2017-103502-02	Water Approval – Water Withdrawal	NSECC	25_Jan-2021	02-Jul-2027
2016-095967-04	Water Approval – Wetland Alteration (58.86 ha)	NSECC	09-09-2020	11-Mar-2026
Lease No. 11-1	Mineral Lease	NS Dept of Lands & Forestry	01-Aug-2011	20 years (01-Aug-2031)
2020-2761069-00	Waste Oil Tank	NSECC	15-Dec-2020	15-Dec-2030
-	Conservation Lands Procurement Plan	NS Dept of Lands & Forestry	15-Apr-2016 25-Mar-2021	22-Mar-2017

1.5.3 Approvals Required for the Project

In December 2020, AMNS submitted an application to NSE (now referred to as Nova Scotia Environment and Climate Change) for an amendment to existing IA (#2012-084244-08) to accommodate proposed modifications to the Approved Project. These modifications included the proposed the WRSA expansion, expansion of the Clay Borrow Area, relocation of the Plant Access Road, and expansion of the TMF.

Upon review of these proposed modifications to the Approved Project, the Minister of Environment and Climate Change determined that a Class I EA under the *Environment Act* and Environmental Assessment Regulations would be required before the existing IA could be amended. Subsequent to this determination, AMNS cancelled plans to expand the TMF and instead is proposing in-pit tailings disposal as part of the modifications to be assessed.

Table 1.3 demonstrates compliance with the requirements for an EA Registration as outlined in the Environmental Assessment Regulations (s.9(1A)). In addition, the *Guide to Preparing an EA Registration Document for Mining Developments in Nova Scotia* (NSECC 2009) has been consulted as guidance in the preparation of this EARD.

Table 1.3 EA Registration Concordance with the Environmental Assessment Regulations

Environmental Assessment Regulations Requirement for Registration	EA Registration Section Reference
The name of the proposed undertaking	Section 1.1
The location of the proposed undertaking	Sections 1.0, 2.1
The name, address, and identification of the proponent.	Section 1.1
A list of contact persons for the proposed undertaking and their contact information	Section 1.1

Table 1.3 EA Registration Concordance with the Environmental Assessment Regulations

Environmental Assessment Regulations Requirement for Registration	EA Registration Section Reference
The name and signature of the Chief Executive Officer or a person with signing authority if the proponent is a corporation	Section 1.1
Details of the nature and sensitivity of the area surrounding the proposed undertaking	Sections 1.3, 2.1, 6.4, 7.4, 8.4, 9.4, 10.4
The purpose and need for the proposed undertaking	Section 1.4
The proposed construction and operation schedules for the undertaking	Section 2.5
A description of the proposed undertaking	Section 2.0
Environmental baseline information	Sections 6.4, 7.4, 8.4, 9.4, 10.4
A list of the licenses, certificates, permits, approvals, and other forms of authorization that will be required for the proposed undertaking	Section 1.5.3
All sources of any public funding for the proposed undertaking	Section 1.6
All steps taken by the proponent to identify the concerns of the public and aboriginal people about the adverse effects or the environmental effects of the proposed undertaking	Section 4.0
A list of all concerns expressed by the public and aboriginal people about the adverse effects or the environmental effects of the proposed undertaking	Section 4.0
All steps taken or proposed to be taken by the proponent to address concerns of the public and aboriginal people	Section 4.0

Upon release from the EA process, AMNS will submit new or revised applications to secure the necessary approvals and authorizations to proceed with the proposed modifications to the Approved Project. These are anticipated to include:

- Amendment of the existing IA (#2012-084244-08) from NSECC
- New or Amended Water Approvals from NSECC to alter wetland habitat within the footprint of the WRSA Expansion
- Work within the Highway Right-of-Way Permit from NS Transportation and Active Transport for work related to the Relocation of the Plant Access Road
- Updated Letter of Authority for activities on Crown land under the existing lease. In particular, the proposed Plant Access Road and WRSA expansion area will be located on Crown land

1.6 FUNDING

The Project will be 100% privately funded.

1.7 SUPPORTING DOCUMENTS

Since operation commenced, a number of supporting technical reports, monitoring, and management plans have been developed for the Project and submitted to various regulatory agencies. In consultation with NSECC, a selection of these has been compiled and is included with this submission (Supporting Documents (SD) attachment).

Technical studies specifically related to this assessment are included as the following appendices:

Appendix A

- A.1 Integrated Water and Tailings Management Plan for the Touquoy Gold Project (Stantec 2021a)
- A.2 Waste Rock Storage Facility Slope Stability Assessment & Design, and November 27, 2020 update (Golder 2020)

Appendix B

- B.1 Atlantic Gold Public Perception Study, March 2020 (AMNS 2020a)
- B.2 Touquoy Modifications, Environmental Assessment Webinar, May 31, 2021
- B.3 Touquoy Gold Project Modifications, Environmental Assessment, Webinar Report

Appendix C

- C.1 CRM Archaeological Resource Impact Assessment (CRM Group 2021)
- C.2 Viewshed Analysis (GHD 2021)

Appendix D

- D.1 Groundwater Flow and Solute Transport Modelling to Evaluate Disposal of Tailings in Touquoy Open Pit (Stantec 2021b)
- D.2 Waste Rock Storage Area Groundwater Modelling Update, Touquoy Gold Mine (Stantec 2021c)
- D.3 Water Quality Predictions for Scraggy Lake and Watercourse No. 4, Touquoy Gold Mine (Minnow 2021)
- D.4 WRSA and TMF Source Terms (Lorax 2020a, 2020b)
- D.5 Touquoy Gold Project Assimilative Capacity Study of Moose River – Touquoy Pit Discharge (Stantec 2021d)

Appendix E

- E.1 Touquoy Gold Mine - Study Area Extension (Square Lake): Wetland and Watercourse Delineation (MEL 2020a)
- Touquoy Mine Gold Project, 2020 Annual Wetland Compensation Report (MEL 2021c)

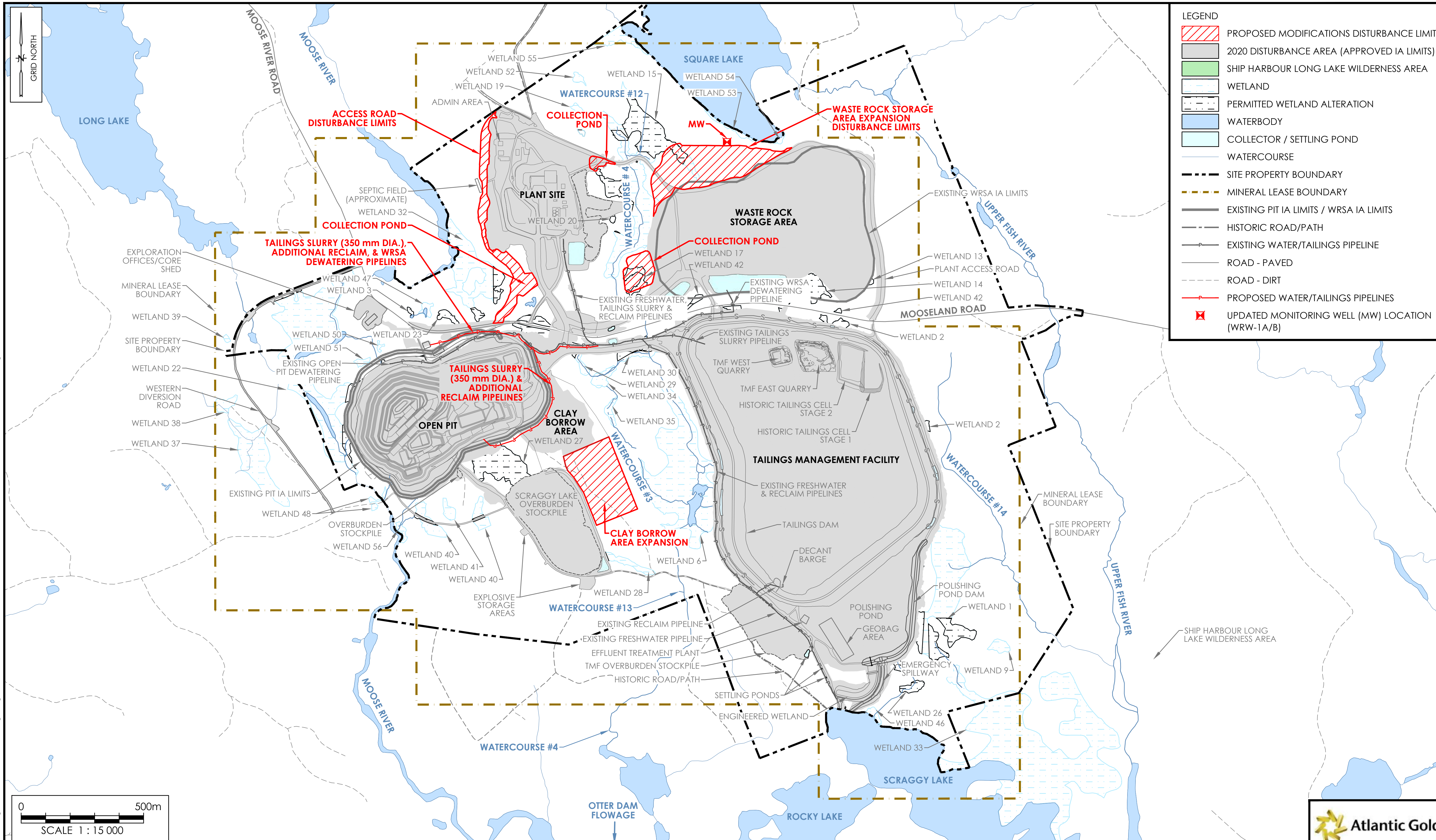
2.0 PROJECT DESCRIPTION

2.1 PROJECT LOCATION AND SITE LAYOUT

The Project is located entirely within the Touquoy Mine Site which is located in Moose River Gold Mines, Nova Scotia, approximately 63 km northeast of Halifax and 19 km southeast of Middle Musquodoboit (Figure 2.1). The Touquoy Mine Site is located within the Eastern Drumlins ecodistrict, a subdivision of the Eastern ecoregion of Nova Scotia. The ecodistrict is characterized by drumlin fields with generally north-south oriented drumlins. The area has relatively low relief with frequent drumlins and numerous lakes, ponds, streams, and wetlands. The Touquoy Mine Site also lies within the Fish River-Lake Charlotte secondary watershed (1EL-5), directly east of the large Musquodoboit River Valley system in central-southeastern Nova Scotia. The Fish River-Lake Charlotte watershed is drained by Fish River, Moose River, and respective tributaries. Catchment areas within the Mine Site drain mainly to the Moose River and its tributaries with the southern area of the property draining to Scraggy Lake. The runoff from the site infrastructure areas has been altered and is managed and controlled by means of collection ditches and ponds with collected water being discharged to Scraggy Lake. A public road (Mooseland Road) bisects the Mine Site. The nearest First Nation land is Beaver Lake Reserve No. 17, which is approximately 13 km from the Touquoy Mine Site, and is associated with the Millbrook First Nation (Section 4.1 contains more information on Mi'kmaq communities in proximity to the Project).

The current approved development area of the Mine Site is approximately 271 ha. The Open Pit occupies a surface area of approximately 27 ha, roads occupy approximately 13 ha, the Mill Facility occupies approximately 60 ha, the TMF is approximately 130 ha and the WRSA is approximately 35 ha. Other ancillary features account for the remaining disturbance (e.g., overburden stockpiles, Plant Access Roads).

For the purpose of this EARD, the Project Development Area (PDA) is defined as the direct areas of disturbance associated with construction, operation and decommissioning of the proposed Project. It comprises the existing Open Pit, the proposed WRSA expansion area, the new Clay Borrow Area, the Right of Way (RoW) of the relocated Plant Access Road, and the area required for ancillary features associated with these Project components (e.g., ditching, monitoring wells, parking lot security guard house). The collective PDA is fully located within the existing Touquoy Mine Site as shown on Figure 2.1, with portions of the Plant Access Road and WRSA expansion located on Crown land that is currently leased by AMNS.



V:\1216\active\121619250\1_geotechnical\3_drawings_logs\2500_TOUQUOY\4_Sheet_Files\12_TASK-2600-EA\121619250.2600_EA_F2.1_REV0.dwg

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

Reference:
1. PROVINCIAL BASE DATA REPRODUCED AND DISTRIBUTED WITH THE PERMISSION OF SERVICE NOVA SCOTIA & MUNICIPAL RELATIONS (SNSMR, 2006) AS PER THE TERMS OF USE OUTLINED IN THE UNRESTRICTED DATA USE LICENSE AGREEMENT FOR GEOGRAPHIC DATA.
2. SITE DATA PROVIDED BY ATLANTIC MINING NS INC. AND McCALLUM ENVIRONMENTAL.

SITE LAYOUT SHOWING PROPOSED MODIFICATIONS
TOUQUOY GOLD PROJECT
HALIFAX COUNTY, NOVA SCOTIA

Client: ATLANTIC MINING NS INC.

Job No.:	121619250
Scale:	1 : 15 000
Date:	25-JUN-2021
Dwn. By:	JL
App'd By:	SW

Fig. No.: 2.1

Stantec

2.2 PROJECT COMPONENTS AND ACTIVITIES

This section describes the various physical components of the Project, including the associated site preparation and construction activities, with reference to operation and maintenance activities where these may differ from the previously approved project (e.g., water management). Decommissioning and reclamation is described in Section 2.3.

2.2.1 In-Pit Tailings Disposal

Currently, tailings from the processing of low and medium grade Touquoy ore are deposited in the TMF as permitted by IA#2012-0824244-08. Once the Open Pit is exhausted (anticipated to be 2022), AMNS proposes to use the exhausted Open Pit as a depository for tailings.

Tailings deposition will be performed using subaqueous deposition of a conventional tailings slurry through a barge. The Open Pit has a conical shape and a total depth (below the spillway) of 132 m. The total capacity of the exhausted Open Pit at the proposed spillway elevation of 108 m is of 8.962 Mm^3. The estimated total volume of Touquoy tailings to be deposited in the exhausted Open Pit is approximately 6.03 Mt.

Currently, the Open Pit is actively dewatered during operation with water from the pit pumped to the TMF. The dewatering operations would be discontinued approximately five months prior to start-up of tailings deposition in the exhausted Open Pit. Once the dewatering operations cease, the inflow of groundwater, surface flow and precipitation into the Open Pit will create subaqueous conditions for tailings disposal.

Tailings may be chemically and physically engineered and deposited as a thickened slurry that consolidates as a relatively impervious material (relative to the Open Pit surround). The existing tailings slurry pipeline from the Mill Facility will be redirected from the TMF to the exhausted Open Pit. The tailings line from the Mill Facility to the exhausted Open Pit it will have the same design as the current tailings line from the Mill Facility to the TMF (e.g., double-walled). Process controls will be in place to detect a pipeline leak or spill and initiate shutdown procedures.

As is current practice for tailings directed to the TMF, water treatment (i.e., cyanide destruction) will occur at the process plant before the tailings slurry leaves the plant for disposal. The tailings will be deposited into the Open Pit by end-of-pipe discharge, beginning in the lower areas and moving radially around the exhausted pit. The tailings discharge pipe will be suspended in the pond by floats or as the Open Pit fills, a floating barge. Initially, the pipe will likely discharge from surface at a lower bench as the bottom of the exhausted Open Pit has a deeper basin. Detailed procedures will be developed for tailings line relocation and corresponding facility shutdowns to prevent plugging of the tailings pipeline.

Summer deposition will be carried out in shallower portions of the Open Pit in preparation for the winter. Bathymetric surveys will be conducted at least once a year during the ice-free period to identify areas where tailings deposition should be concentrated and to create a tailings surface. From the tailings surface, design assumptions of tailings volume and average tailings deposited density can be checked. The tailings deposition plan will be updated routinely to check that capacity is available in deeper parts of the exhausted Open Pit to prepare for winter operation. Winter deposition will occur in deeper zones to avoid beaching of deposited tails where ice lensing has been reported to occur at other Canadian open pit mines (ARCADIS 2015).

The existing TMF reclaim barge will be relocated from the tailings pond to the exhausted Open Pit for reclaim in ore processing for the Project. The reclaim barge will be placed in an area with the highest water depth. A floating baffle curtain will be installed around the barge should high suspended solids become an issue in processing. An average settled tailings density of 1.3 tonnes per cubic metre (t/m^3) was assumed considering subaqueous tailing deposition; thus a lower average deposited tailings density than that of the Touquoy tailings pond of 1.44 t/m^3 practicing sub-aerial deposition.

Based on a review of climate normal temperatures, ice cover in the Open Pit lake may occur as early as December in any given year. Subaqueous deposition employed in cold climates require mitigation strategies to continue deposition when the water surface is frozen. Bubbler systems may be installed around the discharge/reclaim barge and its pontoons to reduce ice formation. The discharge/reclaim barge will be placed over a deep portion of the pond to provide storage of tailings deposited throughout the ice-covered portion of the winter. Another option is to submerge the tailings slurry discharge line below the ice depth to discharge tailings to a single point. Specific in-pit depositional details will be determined during detailed design considering climate factors, standing water depth, Open Pit water surface area, reducing opportunities of differential settlement within the tails, maximizing tailings consolidation, and increasing hydraulic conductivity.

Water management in the Open Pit is an integral part of tailings management. Water balance modelling and water quality modelling have been updated to account for in-pit disposal of tailings and incorporated into an Integrated Water and Tailings Management Plan for the Touquoy Gold Project (Stantec 2021a, Appendix A.1).

Currently, during operation of the Approved Project, site drainage and runoff is directed to the TMF. The Project essentially replaces the TMF with the exhausted Open Pit; accordingly, water management features will be modified to direct surface runoff to the pit instead of the TMF. Water will continue to be managed in the TMF until fully reclaimed.

Start-up process water supply for in-pit tailings disposal will come from precipitation, groundwater inflow, and runoff from site features (e.g., WRSA, Clay Borrow Area, Plant Access Road, existing overburden stockpiles). A minimum of 1.75 m water cover will be maintained above the deposited tailings to facilitate pumping and limit resuspension of tailings. The water cover depth will vary over the tailings depositional period.

Throughout operation as the Open Pit fills and becomes a lake, it will be treated as a batch reactor with the objective of adjusting the pH to precipitate metals thus improving discharge quality. Water levels in the pit will be maintained below the spill elevation of 108 m until water in the Open Pit lake meets MDMER discharge limits. Surplus water in the Open Pit will be treated *in situ* or pumped and treated in an adjacent treatment plant or existing Touquoy ETP (Effluent Treatment Plant) at a rate of approximately 400 m^3/hr.

The top of the tailings will be maintained to 2 m below the spillway elevation to protect the bed sediments from disturbances due to wave action and ice entrainment (i.e., approximately 10% deeper than the maximum ice thickness, MEND 1998).

Once water quality meets regulatory reclamation criteria without treatment, the site is prepared for closure, in accordance with the Touquoy Reclamation and Closure Plan. Surplus water in the exhausted Open Pit will be allowed to discharge via the proposed spillway/conveyance channel to Moose River, subject to meeting regulatory discharge criteria.

2.2.2 WRSA Expansion

AMNS is proposing to expand the current WRSA to increase storage capacity for waste rock and low/medium grade ore. As originally designed in 2017, the WRSA had a storage capacity of 10.8 Mm^3. Since then, the capacity of the WRSA has been reduced due to environmental controls that have been constructed on the site and the delineation of a wetland within the planned development area of the WRSA (Section 1.4). In addition to these spatial reductions, as ore within the Open Pit is classified as either waste, or potential low-grade / medium grade material, it has been managed by segregation within the WRSA to allow for potential future extraction and processing. This type of waste-ore material management requires additional space.

The current approved design of the WRSA is for a surface footprint of 35 ha, with an elevation of 170 metres above sea level (MASL) and piles designed for stability in 10 m lifts at an overall slope of 3:1. Testing completed to date on the waste rock suggests that between 13% and 21% of this material is potentially acid generating (PAG). However, the potential for onset of acid rock drainage (ARD) in the WRSA is considered low (Lorax 2020a). AMNS has developed and implemented a Metals Leaching (ML)/ARD Management Plan (Lorax 2020c) to mitigate risk of ARD development.

The current approved WRSA reached its storage capacity in the spring of 2021. Although AMNS has identified the potential for temporary in-pit storage, this alternative solution requires repeat handling of the material and not provide a long-term solution. To reestablish lost capacity, maintain stable height requirements, and accommodate future growth, the WRSA will require an additional 2.5 Mm^3 of storage capacity.

The proposed WRSA expansion is approximately 7.1 ha (increasing the total footprint of the WRSA to 42.1 ha) and includes area outside of the existing approved IA limits to the north/northwest (Figure 2.1). The new waste rock storage piles will be constructed in 10 m lifts in accordance with the requirements of the Touquoy Gold Project Reclamation Plan (Stantec 2020a) The WRSA has been designed to hold both waste rock (non-economic material) and low/medium grade ore. The proposed WRSA height is designed to an elevation of 170 MASL. A stability analysis supporting the design for the current development area of the WRSA is included in Appendix A.2 (Golder 2020).

Approximately 7.1 ha of land will be cleared to increase the development of the WRSA. Felled trees will be mulched on site. Surface topsoil and peat will be removed to deposit waste rock directly on the existing clayey till layer for the required geotechnical stability.

The WRSA Expansion will require alteration to Wetland 15 at two locations (Figure 2.1), for an approximate total of 0.6 ha of which 0.32 ha has not been previously permitted for alteration. Wetland 15 is a natural 9.46 ha coniferous and shrub swamp located to the west of the proposed WRSA expansion and is the source water of Watercourse # 4 which flows through WL30 and WL6. Environmental effects of this proposed wetland alteration would be consistent with those assessed previously for the Touquoy Gold Project, but the alteration will require an amendment to the existing Approval for Wetland Alteration (Approval # 2016-095967-04). The application for amendment will include specific details on Wetland 15, the effects of the proposed alteration, and mitigation, monitoring and compensation. More information on alterations to wetlands as part of the WRSA Expansion is provided in Section 9.0.

The existing WRSA has been used for waste rock disposal since 2017. No sign of instability has been observed in the existing piles (Golder 2020; Appendix A.2).

Currently, within the approved WRSA, waste rock is placed on the central and southeastern side of the footprint, whereas low-grade and medium grade ore are placed at the western side. Waste rock is typically free dumped directly from the haul truck on the flat surface and the above lift is dumped and pushed with a dozer so that a new flat surface allows haul truck circulation, thereby building two lifts of approximately 2 m thick. This placement method is followed to make up a 10 m high bank.

The continued development of the WRSA will be monitored by site surveyors to confirm compliance with the designed geometry. The Chief Engineering Officer is responsible for coordinating formal inspections to confirm the WRSA is behaving as expected and to identify problematic areas requiring rectification if necessary. Inspections include daily patrols carried out by personnel working routinely on the structure, formal monthly or fortnightly inspections carried out by the engineering department, and special inspections carried out by the engineering department and external geotechnical consultants as required. In the event that signs of deformation are observed, construction activities will cease and conditions will be reassessed. (Golder 2020; Appendix A.2). Additional information on slope stability and the surveillance program associated with the WRSA is included in Appendix A.1.

The ongoing use of the WRSA and potential environmental interactions are as described in the EARD for the Touquoy Gold Project (CRA 2007a) and associated Focus Report (CRA 2007b) and approved by the current IA (IA# 2012-0824244-08).

Expansion of the WRSA will require relocation of the Plant Access Road (Section 2.2.4) and updates to water management and drainage infrastructure (Figure 2.1). The attached memo describes the design criteria and highlights differences from previous design basis for the WRSA (Stantec 2021j; Appendix A.3). In general, it is understood that the Phase I and Phase II designs are functioning adequately. Therefore, the same general design criteria, concepts and methodology used for the Phase I and II design have been used for Phase 3.

A geotechnical investigation was completed in January 2021 to support the design of the Phase 3 drainage ditch (Stantec 2021k; SD 23). The general subsurface conditions encountered at the test pit locations consisted of vegetation and rootmat overlying silty SAND (SM) with gravel, underlain by till and inferred bedrock. The wetland area in the footprint of the WRSA if left in place may promote the pooling of water and impact slope stability of the pile. For drainage purposes, it is prudent to excavate unsuitable materials in the area and replace with local borrow clay till graded to promote drainage to the ditch.

Phase 3 of the design includes the addition of perimeter ditching along the north and northwest of the WRSA. The ditches are to be excavated into native till/bedrock or lined on the exterior slope and bottom with clay till liner to reduce seepage from the ditches to the surrounding environment. In addition, there is a section to the north that incorporates a buried culvert. The culvert was selected as the preferred option based on discussions with AMNS. Design criteria are provided in Appendix A.3.

A groundwater monitoring well (WRW-1A/B) is located within the development area of the proposed WRSA expansion. Monitoring of this well is required as a part of the current IA (IA# 2012-0824244-08). AMNS is proposing that the replacement well be installed to the north of the current wells, outside of the proposed WRSA limits, and that it be installed prior to decommissioning of WRW-1A/B. AMNS is also proposing to complete a series of sampling events of both wells to allow for data overlaps to be used relating the new well to the baseline data set of WRW-1A/B. A preliminary location for the new well is shown on Figure 2.1; the exact location of the new wells will be finalized based on input from NSECC and submitted to NSECC for approval prior to installation.

Drainage ditches and ponds associated with the current WRSA collect and convey surface water runoff and shallow seepage from the WRSA stockpile to the TMF. Runoff from the western area of the WRSA is currently collected via perimeter ditching and diverted to a western storage pond before being pumped to the TMF, as described in the attached design memo (Appendix A.3). However, based on the results of this of this EA, a design that relays flow to Watercourse #4 has been developed in order to reduce environmental effects on water quantity. With the proposed expansion of the WRSA, approximately 21 ha of the western area of the WRSA (16 ha of existing and 5 ha of the expanded WRSA area) will be diverted via the planned perimeter ditching described above and in Appendix A.3 to a newly constructed pond for sediment removal before being drained to Watercourse #4 in the headwater area upstream of Mooseland Road (Figure 2.1).

2.2.3 Clay Borrow Area

Clay is used at the Touquoy Mine Site for various needs including construction of the TMF dam clay core, and construction and maintenance of ditching for surface water, seepage, and runoff management. The current Clay Borrow Area is located at the southeastern corner of the existing approved borrow area (Figure 2.1). The current approved Clay Borrow Area is 8.4 ha. This includes an area of approximately 1.82 ha which was added to the approved Clay Borrow Area in 2020 due in part to sub-standard clay material in the original borrow area (e.g., notable increase in sand, gravel, and cobble content of the soil). At that time, a third-party source of clay was also identified off-site. The construction of the Plant Access Road and the WRSA expansion will require more clay than what is currently available from the approved sources. Therefore, the Project includes a proposed expansion (approximately 5.9 ha) of the existing Clay Borrow Area. This proposed expansion is located within the study area boundaries assessed for the Touquoy Gold Project EA (CRA 2007a), but includes land outside of the currently approved development area.

The proposed Clay Borrow Area expansion area is located on lands acquired by AMNS in 2020. A biophysical survey (wetlands, watercourses, habitat, rare species) was conducted in October 2020 when AMNS purchased the property. Expansion of the Clay Borrow Area will avoid environmentally sensitive features (e.g., wetlands, watercourses, rare vegetation) (Figure 2.1).

Site preparation for the use of the expanded Clay Borrow Area will consist of incremental clearing and grubbing on a seasonal basis. Clay will be extracted from the Clay Borrow Area on an as-needed basis. Borrow excavation will be terminated at or above bedrock.

Perimeter ditching will be constructed to collect runoff from the expanded Clay Borrow Area and direct it to the Open Pit.

2.2.4 Relocation of the Plant Access Road

The existing Plant Access Road provides access to the Plant Site which includes the Mill Facility, run-of -mine stockpile, warehouse, truck shop, and several administration buildings. It currently runs north of the WRSA within the area of the proposed WRSA expansion. A new proposed Plant Access Road will therefore be constructed to retain access to the Plant Site from Mooseland Road. This new route will also increase site safety by diverting traffic and reducing traffic crossing the primary haul road. (Figure 2.1). The existing Plant Access Road will become defunct once the new road is built and is operational, although the public section of BillyBell Way will be kept open (from Mooseland Road north to Square Lake) to maintain access to other crown land properties north of the Mine Site.

The proposed relocated Plant Access Road will be approximately 1,278 m long with an average driving width of 14.6 m. Taking into account the total length and width of the road including ditches and grading slopes, the total approximate footprint of the Plant Access Road will be 4.45 ha. The new design requires small modifications to signage, gates, security shack and parking lot (approximately 0.65 ha) at the Plant Site. Construction of the proposed replacement Plant Access Road will require clearing a RoW approximately 20 m in width. The new proposed Plant Access Road and ancillary works are all located within the Mine Site property boundary and within the Development Area previously assessed (CRA 2007a, 2007b) and approved for operation (IA# 2012-0824244-08).

The proposed route for the relocated Plant Access Road has been designed to avoid sensitive environmental features (i.e., wetlands, watercourses, rara plants). Certain road construction activities will take place around a septic field and will be managed to avoid damages to the existing septic infrastructure. AMNS is committed to engaging a qualified professional should modifications to the septic system be required; at this time, no modification is expected.

Following surveying and clearing for the New Plant Access Road, grubbing, and grading will be conducted and a roadbed constructed. The road will be constructed from waste rock and gravel sourced from the Mine Site.

The new Plant Access Road has been designed to include sediment control features in the accordance with the Erosion and Sediment Control Plan for the Touquoy Gold Project (Stantec 2020b). The design includes a berm along the western side of the road, with surface grading to a ditch which will run along the eastern side of the road conveying stormwater runoff to a clay lined containment pond located at the low point along the road. The pond will be fitted with pumping infrastructure to convey storm water to the TMF or the Open Pit. Drainage and ditching associated with the relocated Plant Access Road are shown on Figure 2.1.

The proposed Plant Access Road will relocate existing Mine Site traffic and will not result in an overall increase in mine traffic. Traffic speed will be limited to 40 km/hour on the proposed Plant Access Road. As is currently done for access/haul roads at the Mine Site under the Fugitive Dust Control Plan (Appendix 5 of the Air Quality Management Plan for the Touquoy Gold Project), the relocated Plant Access Road will be watered as required to prevent generation of dust.

2.3 DECOMMISSIONING AND RECLAMATION

A Reclamation Plan (Stantec 2020a) has been prepared to provide details of the proposed decommissioning and reclamation activities at the Touquoy Gold Project including progressive reclamation, final closure, and post-closure monitoring. The goal of reclamation is to return the physical, chemical, and biological qualities of the land and water regimes disturbed by the Touquoy Gold Project to a state that is safe, stable, and compatible with the surrounding landscape and final land use. The final land use of the Crown lands will require approval from the Nova Scotia Department of Lands and Forestry and NSDEM. NSECC also reviews and provides comment on reclamation plans.

As outlined in the 2011 Preliminary Reclamation Plan (CRA 2011), initial land use activities identified by stakeholders for the post-mining landscape included outdoor recreation and commercial forestry. Continued engagement and dialogue with the public regarding the mine's operational and closure planning is completed via the Community Liaison Committee (CLC) and in ongoing engagement with the Mi'kmaq of Nova Scotia and the public at large. It is anticipated that based on the results of this ongoing engagement, that the final land use concepts during post-closure will continue to evolve (Stantec 2020a).

The Reclamation Plan is updated a minimum of every three years or six months prior to the planned end of mining as the final closure plan. The Plan is also updated following major changes to the Touquoy Gold Project and reclamation measures. The Reclamation Plan was most recently revised in November 2020 (Stantec 2020a) in response to comments received from NSECC and NSDEM and will be updated again once regulatory approval is obtained for the proposed modifications assessed within this EARD.

Most of the proposed modifications which comprise the Project assessed in this EARD represent expansion or relocation of existing components and will not materially change closure objectives, criteria, reclamation activities, performance monitoring and planned research studies as outlined in the most recently approved Reclamation Plan (Stantec 2020a). The in-pit tailings disposal represents a new component not previously addressed in the Reclamation Plan but is contained in the footprint of the Open Pit. The following sections outline potential modifications to the Reclamation Plan and activities based on updates to the Approved Project including modifications assessed in this EARD.

2.3.1 Open Pit

The recently submitted Reclamation Plan (Stantec 2020a) does not account for in-pit tailings disposal as part of the Approved Project. The Reclamation Plan currently assumes at closure, the Open Pit will be allowed to flood naturally over time with a combination of groundwater inflow, direct precipitation, and surface run-off to create a permanent lake with a shallow shoreline and a spillway to Moose River. Access to the Open Pit would be maintained by existing ramps to allow safe access during pit-flooding and post-closure phases.

As indicated in Section 2.2.1, there will be an earlier in-filling of the pit due to tailings deposition and conveyance of site runoff to the pit. However, the general closure concept for the pit remains applicable whereby a shallow slope at the water line will be created with vegetative cover above the final water elevation, which would remain the same. Pit ramps will be maintained with the addition of safety berms for safe vehicular access to the pit lake during pit flooding and for post-closure monitoring.

Open Pit filling will be accelerated by directing a portion of the WRSA flows that do not drain to Watercourse #4 to the pit until the pit lake reaches the elevation of the spillway. In addition, the expanded Clay Borrow Area will be directed to the pit until reclamation of this feature. The proposed closure shoreline geometry will ensure all water draining through the till/bedrock interface is directed to the lake. The barrier berm may be breached in locations to allow the surface runoff from nearby site areas to similarly drain into the Open Pit. Refer to Section 2.2.1 for a description of treatment and discharge of water from the pit lake during closure.

2.3.2 WRSA

The current approved Reclamation Plan describes the following closure activities for the WRSA:

- progressive re-sloping and vegetation of the WRSA slopes
- re-sloping of the final lift of the WRSA
- contouring the ultimate top surface of the WRSA
- providing a vegetated cover for closure
- grading and contouring the collection ditches and ponds

The re-sloping of the final lift, placement of a soil cover and revegetation treatments will be completed following end of mining. A portion of surface water runoff from the west WRSA will be directed to Watercourse #4 as to not reduce the flow to the watercourse due to the WRSA and Clay Borrow Area expansion. The runoff will be released through a water management pond prior to gravity drainage to the Watercourse #4. At closure, collection ditches and ponds will be removed, and areas graded and vegetated once they are no longer required based on the above.

Proposed expansion of the WRSA does not materially change the progressive reclamation plan, final reclamation plan or proposed closure studies for the WRSA previously submitted to NSECC. Erosion modelling and field vegetation trials are currently underway at the site. Outcomes of these studies and trials will be used to complete detailed design of re-sloping and vegetation requirements. At this time the proposed slopes and vegetation cover described in the Reclamation Plan are proposed for use on the WRSA slopes.

2.3.3 Clay Borrow Area

At mine closure, all disturbed areas within the Clay Borrow Area will be regraded and re-vegetated as per the Reclamation Plan. This will include final contouring to 3H:1V where applicable. Surface water runoff will be graded toward pre-development areas, where practical.

2.3.4 Plant Access Road

Following mine closure, the relocated Plant Access Road will be maintained as necessary to provide ongoing access for closure activities. Upon decommissioning and removal of buildings at the Mill Facility and Admin Area, the Plant Access Road will be reclaimed. To facilitate vegetation, the road surface will be scarified, capped with a layer of salvaged soil, and seeded. This approach is consistent with reclamation planned for other on-site roads during closure activities, although timing of reclamation may differ depending on required access to other facilities during closure.

2.4 WASTES, DISCHARGES AND EMISSIONS

Construction vehicles and machinery associated with the Project activities will generate air and noise emissions. Fuel combustion from construction vehicles and machinery will result in the emission of greenhouse gases (GHG) and air contaminants, including carbon dioxide, sulfur dioxide, nitrogen oxides, carbon monoxide, volatile organic compounds, and particulate matter (PM, PM_{10}, $PM_{2.5}$). Greenhouse gases from vehicle emissions will be managed according to the GHG Management Plan which is included as Appendix 1 of the Air Quality Management Plan for the Touquoy Gold Project (CRA 2008). These emissions will be localized, temporary, and consistent with current emissions generated as part of the Approved Project. Ambient air quality monitoring will continue to be conducted annually in accordance with IA Approval (#2012-084244-08) requirements for the Approved Project.

Construction activities, including clearing and site preparation and movement of equipment and vehicles, will also result in fugitive dust emissions. Dust from Project activities will be managed as per the existing Fugitive Dust Emissions Plan (Appendix 5 of the Air Quality Management Plan for the Touquoy Gold Project (CRA 2008)) and the Atlantic Gold EPP (AGC–PLN–ENV-002) (AMNS 2020b; SD 1). The site access road and parking lot will be watered and maintained in the same manner as roads elsewhere on the site. Environmentally friendly (cellulose-based) binding agents may be applied to light vehicle traffic areas to stabilize surface material and prevent dust generation. The parking lot fence with employ a fabric environmental barrier to prevent dust generated in the service complex from blowing into surrounding areas. In all areas of the site, bands of trees will remain to provide a natural barrier to view, noise, and dust. Effects associated with dust emissions are anticipated to be temporary and localized.

As per the EPP for the Touquoy Gold Project, sound levels measured at stations situated at or beyond the Project property boundaries will not exceed the following equivalent sound levels (Leq – Equivalent Continuous Sound Pressure Level):

- 65 dBA 0700-1900 hours (Days)
- 60 dBA 1900-2300 hours (Evenings)
- 55 dBA 2300-0700 hours (Nights)

Waste management will comply with provincial requirements and the EPP for the Touquoy Gold Project. Fuels, oil, and lubricants will be stored, handled, and disposed of according to applicable regulations and AMNS's EPP for the Touquoy Gold Project.

2.5 PROJECT SCHEDULE

The following project schedule assumes that all required permits, approvals, and authorizations would be in place. As discussed throughout the document, there is an urgent requirement to expand the WRSA along the timeline presented.

Table 2.1 Schedule for Construction, Commissioning, and Decommissioning of Modified Project Components

	Construction Period	Commissioning Date (required by)	Decommissioning
In-pit Tailings Disposal	Fall 2021(in approved areas of disturbance)	June 1, 2022	This facility will be decommissioned when tailing processing end. For Touquoy alone this would be in approximately 2025. If other sites are permitted, this could extend to approximately 2033
WRSA Expansion	Spring 2022 (or as soon as permitting is secured)	Spring 2022. This facility is required as soon as possible and before June 1, 2022	Fall 2022 (start of progressive rehabilitation)
Clay Borrow Area	Spring 2022	Spring 2022	The expected life for this facility is 12 years, pending approvals for other sites. Clay may be required for the life of the mine site to support construction activities including during closure
Plant Access Road Relocation	Winter 2022 (as soon as approvals are in place)	Winter 2022 – the Plant Access Road Relocation is required ahead of WRSA Expansion to allow for continuous access	The expected life for this facility is 12 years, pending approvals for other sites

2.6 PROJECT ALTERNATIVES

Proposed modifications to the Touquoy Gold Project are needed to support ongoing operation. Without implementation of these modifications as proposed, operation at the Touquoy Mine Site may be interrupted or terminated. Table 2.2 summarizes an analysis of alternative means of carrying out the Project to meet the overall needs of the Touquoy Gold Project.

Table 2.2 Summary of Alternatives

Alternative Category	Consideration of Alternatives	Preferred Option
Tailings Management	Tailings from the Touquoy Gold Project are currently disposed in the TMF. However, the TMF is nearing capacity. To increase the storage capacity of the TMF, the elevation of the TMF would have to be raised by increasing the upstream slope profiles and modifying the core alignment of the TMF. Although raising the TMF is a feasible option, it would require regulatory approval and would only create a temporary solution for tailings management at the site. In-pit tailings disposal is a feasible alternative which provides a permanent and environmentally acceptable solution to tailings management at the Mine Site. Within the option of in-pit tailings disposal, there are also different placement techniques: subaerial discharge and subaqueous injection of tailings below the tailings surface. Both techniques were evaluated in the Integrated Water and Tailings Management Plan (Appendix A.1). Subaerial tailing deposition could be by end-of-pipe 10 meter down the pit face thus limiting the amount of infrastructure required. However, this method could result in the formation of a turbulent zone and the resuspension of tailings particles and tailings could be susceptible to ice formation from winter exposure. Subaqueous placement reduces worker exposure to dust, provides for less tailings segregation and lower hydraulic conductivity in consolidated tailings. Depositing the tailings under a water cover will limit particle segregation, increase consolidation, and prevent frost lens formation in tails that may pile above the water line or in the winter ice formation zone. A water cover also inhibits further oxidation of sulphide minerals and acts as a barrier to the diffusion of atmospheric oxygen to the submerged sulphides (MEND 2015). Although the tailings are expected to be low metal leaching and non-acid generating, a water cover is expected to further improve water quality in the pit lake.	In-pit tailings disposal (with subaqueous placement) as assessed in this EARD
Waste Rock Disposal	Ore within the Open Pit is classified as either waste, or potential low-grade / medium grade material. These materials are managed by segregation within the WRSA. Based on the current operation, the WRSA is rapidly reaching its capacity. Although AMNS has identified the potential for temporary in-pit storage (i.e., for a few months), this alternative solution would require repeat handling of the material and not provide a long-term solution. To reestablish lost capacity, maintain stable height requirements, and accommodate future growth, the WRSA requires expansion. Engineering design will consider various design options for the WRSA that will accommodate additional growth while maintaining stability of the WRSA. An alternative to expanding the existing approved WRSA is to establish a new WRSA on the site. This option would create a new footprint of environmental disturbance (including requirements for new drainage controls) and potentially result in operating inefficiencies including increased transportation and associated air, dust, and noise emissions.	Expansion of the WRSA as assessed in this EARD

Table 2.2 Summary of Alternatives

Alternative Category	Consideration of Alternatives	Preferred Option
Clay Borrow Area	Clay is used at the Touquoy Mine Site for various needs including construction of the TMF dam clay core as well as construction and maintenance of ditching for surface water, seepage, and runoff management. The source of usable clay within the approved Clay Borrow Area has been exhausted and the Touquoy Gold Project requires an additional clay source. As an alternative to expanding the permitted Clay Borrow Area at the Touquoy Mine Site as is currently proposed, AMNS could continue to source clay from an off-site third party. This option is currently being used to allow for continued TMF construction, but is not considered a long-term option for the Project. This option also requires additional trucking traffic and potentially results in off-site environmental effects beyond the control of AMNS.	Expansion of Clay Borrow Area as assessed in this EARD
Plant Access Road	Expansion of the WRSA will impinge on the current Plant Access Road therefore it is not a feasible option to maintain the current Plant Access Road. The replacement Plant Access Road must provide access from Mooseland Road to the Plant site so routing alternatives are limited. Routing criteria includes safety of operation, preferred avoidance of environmentally sensitive features (e.g., wetlands, watercourses, and rare plants), and impacts to public use of Mooseland Road. The proposed route for the replacement Plant Access Road was selected in consideration of these criteria and reflects an alignment modification made to an earlier route design in order to avoid occurrence of a rare lichen species. No other road options were considered to be feasible.	Replacement of Plant Access Road using route as proposed and assessed in this EARD.

3.0 ENVIRONMENTAL MANAGEMENT AND MONITORING

3.1 ENVIRONMENTAL MANAGEMENT SYSTEM

AMNS has designed and implemented a series of management procedures and monitoring programs that integrate engineering design and environmental planning to avoid or reduce environmental effects of the Touquoy Gold Project to the greatest extent practicable. These plans form the basis for the Environmental Management System (EMS) to be implemented throughout the life of the Touquoy Gold Project. The EMS acts as the primary environmental management tool for all construction, operation and closure works associated with the mine and consists of three key elements:

- A series of integrated environmental management plans (EMPs)
- A formal employee site induction and training program with an environmental awareness and management component
- A series of ongoing environmental monitoring programs

Environmental Management Plans (EMPs) for the Touquoy Gold Project are listed below along with a description of ongoing environmental monitoring programs. Environmental performance of the Touquoy Gold Project is discussed within the framework of these environmental monitoring programs. This discussion helps to provide context for the proposed modifications at the Mine Site.

3.2 ENVIRONMENTAL MANAGEMENT PLANS

The Environmental Protection Plan (EPP) (SD 1) is a key part of the EMS for the Touquoy Gold Project. The EPP serves as a single reference document to facilitate field implementation of permit and regulatory requirements and to reduce the effect of the Touquoy Gold Project on the environment and surrounding communities.

The EPP is a working document for use by personnel working on the Touquoy Gold Project (including contractors and consultants), providing guidance and measures so that potential adverse environmental effects are avoided or reduced to the greatest extent practicable The EPP provides a quick reference for personnel to monitor for compliance and such that a high level of importance and effort is placed on the protection of the environment. This EPP provides general protection measures for routine and unplanned activities associated with the Touquoy Gold Project, developed in recognition of applicable permits, approvals, and regulations, and will apply to the proposed modifications as relevant. The EPP is updated as necessary based on management reviews, incident investigations, regulatory changes, or other Project-related changes.

The EPP also cross references other relevant documents including other management plans. Table 3.1 contains information on the management plans that exist for the Touquoy Gold Project and that may be applicable to the proposed modifications as applicable.

Table 3.1 Summary of Management Plans

Management Plan	Plan Overview	Project Applicability	Plan Updates Required?
Environmental Protection Plan (SD 1)	Provides general protection measures for routine and unplanned activities.	Proposed modifications affect existing facilities and site infrastructure.	A summary of the updates required is provided in the SD 1.
Air Quality Management Plan	Three key aspects covered include approach to GHGs and estimates of emissions, stack emissions (includes mercury emissions estimate and exhaust stack design), and dust management. The Fugitive Dust Control Plan provides details on monitoring, mitigation, and corrective action for construction and operations phases related to dust, specific to the Project.	Construction will result in temporary atmospheric emissions, but no changes are predicted for operation.	No plan updates are required, as predicted air, noise and light emissions will be consistent with those identified for the Approved Project.
Arsenic Contaminated Soil Management Plan	Describes how soil containing arsenic concentrations above the established background level is to be handled onsite.	Related to use of construction materials sourced on site.	No plan updates are required as the Project does not require soil to be disposed of in the exhausted Open Pit.
Blast Plan	The plan lays out in detail how blasting operations are conducted, including blast monitoring.	The plan is applicable to the Project, as the plan is specific to the Open Pit, for which operations will not change.	No plan updates are required as the Project does not require any change to Open Pit operation (blasting).
Burn Management Plan	The plan was specifically developed to manage the removal of piles of non-merchantable timber by burning during initial site preparation.	The plan is not applicable to the Project, as there are no plans for burning of non-merchantable timber with Project construction	No plan updates are required as the Project does not require burning on site.
Complaint Resolution Plan	Standardizes the formal response procedure to complaints from the public received directly by AMNS in association with the mine.	The plan is applicable to the Project in terms of public interest	No update required as the current plan would apply to the Project.
Copper Sulphate Management Plan	A contingency plan for the removal of copper from tailings in the event that concentrations become higher than expected based on modelling.	The plan is not specifically applicable to the Project.	No plan update required as the Project does not require a change to the use of copper sulphate for cyanide destruction prior to disposal of tailings. The plan is reviewed annually and updated as required.

Table 3.1 Summary of Management Plans

Management Plan	Plan Overview	Project Applicability	Plan Updates Required?
Emergency Response Plan (SD 22)	The ERP identifies potential environmental, health and safety emergencies that could arise at the Moose River Consolidated operation. It establishes the framework for responding to these situations and to all aspects of the operation. It is also made up of related response plans including the TMF Emergency Preparedness and Response Plan (TMFEPRP) and the Operational Preparedness and Response Plan (OPRP). The TMFEPRP provides an emergency response protocol in the event of an emergency at the TMF, outlining responsibilities of key personnel, providing guidance on identifying an existing or potential emergency and the severity of the emergency as it relates to potential failure of the TMF or impact on the environment. OPRP is for the scenario where the water levels within the TMF encroach within the zone designated for Inflow Design Flood storage.	The Project involves modifications to existing facilities, site operation and site infrastructure.	A summary of the updates required is provided in SD 22.
Environmental Effects Monitoring Plan (SD 12)	MDMER requires the monitoring of environmental effects in the receiving environment.	The EEM is relevant to the Project should there be a need for a new discharge point (i.e., Watercourse #4).	No changes to the current Phase 1 EEM for the final discharge point at Scraggy Lake. EEM studies will be required, and will involve effluent characterization, effluent compliance monitoring and water quality monitoring studies. Biological monitoring studies may be required.
Erosion and Sediment Control Plan (SD 2)	The plan consists of drawings showing existing conditions and known future conditions, and corresponding text detailing the erosion and sediment controls in place or that will be implemented.	The Project involves changes to the site layout, and construction activities may result in erosion and sedimentation if not properly managed.	The plan will require an update to show the new proposed site layout, and any subsequent changes to the erosion and sediment controls.
Fugitive Dust Emissions Plan	The plan describes the control measures and practices to be employed to reduce and control fugitive dust.	Relevant to the dust control during all phase of Project activities.	The plan includes all of the general elements that comprise the Project, and therefore no updates are required.

Table 3.1 Summary of Management Plans

Management Plan	Plan Overview	Project Applicability	Plan Updates Required?
Groundwater Contingency Plan (SD 3)	The plan defines procedures to be taken in the event that an adverse effect on groundwater is detected through the Groundwater Monitoring Plan.	The Project involves changes to the site infrastructure, including the relocation of an existing monitoring well and expansion of the WRSA which could affect groundwater resources.	A summary of the updates required is provided in SD 3.
Historic Tailings Management Plan	The plan provides a methodology for managing historic tailings at the Touquoy Mine Site through the life of operation and throughout reclamation.	Relevant to the disposal of historic tailings.	No updates required to the current plan.
Mainland Moose Management Plan	The plan outlines protocols to monitor usage of the Project Area and surrounding landscape by Mainland Moose, minimization of Moose-Human interaction, and support research, education and stewardship related to Mainland Moose recovery.	The Project is unlikely to result in a change to the management of moose.	No updates required as the current plan would apply to the Project.
Metal Leaching/Acid Rock Drainage Management Plan (SD 4)	The Plan formalizes the ML/ARD monitoring procedures in place at the mine as well as provides guidance with respect to best practice ML/ARD mitigation strategies that may be considered at the mine should the results from the monitoring program indicate mitigation is necessary	Directly relevant to surface water, groundwater and fish and fish habitat VCs as the plan involves management of tailings and waste rock.	No updates required as the current plan would apply to the Project.
TMF Operation, Maintenance and Surveillance (OMS) Manual	Reference document for the OMS of the TMF, which provides a documented framework for actions, and a basis for measuring performance and demonstrating due diligence during the operation phase of the Touquoy Mine.	Proposed modifications affect existing facilities and site infrastructure.	The plan will require an update to include the in-pit tailings disposal overview and operation.
Reclamation Plan (SD 6)	This plan provides details of the proposed Project activities including progressive reclamation, final closure, and post-closure monitoring.	Modifications to the Approved Project will require reclamation.	The plan will require an update to show the new proposed site layout, and any subsequent changes to the reclamation of the expanded infrastructure.

Table 3.1 Summary of Management Plans

Management Plan	Plan Overview	Project Applicability	Plan Updates Required?
Spill Contingency Plan	Plan of action for prevention, response to, and recovery of the uncontrolled release of hazardous material to the environment. Supplements ERP.	Directly relevant to Surface Water, Groundwater, and Fish and Fish Habitat VCs. The Project involves changes to the site layout.	The plan will require a minor update due to the new proposed site layout and operation.
Water Management Plan (SD 5)	The plan identifies mitigation to reduce water quality impacts on receiving waters, to maintain the Project in compliance with regulatory requirements and approval conditions.	Directly relevant as the plan involves management of site water and the proposed modifications will affect surface water flow at the site	A summary of the updates required is provided in SD 5.
Tailings Deposition Plan	The current plan outlines the tailings deposition plan for 2019 through 2021, tailings storage volume calculations and deposition schedule.	The Project will have a direct influence on future versions of the plan since tailings will be deposited in the exhausted Open Pit instead of the TMF.	The next iteration of the plan (addressing tailings deposition for 2022 and beyond), will be required to address the deposition of tailings in the exhausted Open Pit.
Wetland Compensation Plan	The plan is an annual report on wetland compensation, identifying the actual area of wetland habitat altered, and documenting the wetland compensation activities completed to date.	The Project will result in additional wetland alteration which will require compensation.	The plan, in the form of an annual report, will reflect any additional wetlands affected by the Project.
Wetland Protection Plan (SD 7)	The plan provides an overview of methods by which wetlands existing within the development area, adjacent to and down-gradient of the development area are protected.	The Project will result in additional wetland alterations.	The plan will be updated to reflect current wetland conditions, and any new wetland information relevant to the Project.
Wildlife Management Plan (SD 8)	The plan outlines protocols to mitigate interactions between terrestrial wildlife and Project activities.	Applies generally to the management of terrestrial wildlife at the site.	No update required as the current plan would apply to the Project.

3.3 ENVIRONMENTAL MONITORING AND PERFORMANCE

Current monitoring programs for the Touquoy Gold Project are listed in Table 3.2. These monitoring programs are required to comply with Section 12c of the IA. Changes to these monitoring programs may be required to accommodate the proposed modifications.

Table 3.2 Current Touquoy Gold Project Monitoring Programs

Monitoring Programs	Frequency/Timing
Masses and Volumes Reporting	Annually
Dam Safety Inspections and TMF Capacity Reviews	Semi-annually
Surface Water and Groundwater Monitoring	Groundwater sampling is conducted quarterly, surface water sampling is conducted monthly, reporting is annually
Ambient Air Quality Monitoring	Annually (over 7-day sampling period)
Blasting Monitoring	For each blast, annual reporting
Metal Leaching and Acid Rock Drainage Monitoring (mine rock and tailings)	One waste rock is required to be tested for every 100,000 tonnes of ore mined, annual reporting
Wetland Monitoring	Annual monitoring started in 2017. Required for no less than five years following alterations
Environmental Effects Monitoring (EEM)	Phase I EEM field program initiated in 2020. One phase every three years
Mainland Moose Management Plan	Annually

The following outlines the results of monitoring programs to the end of 2020, giving an indication of environmental performance of the Touquoy Gold Project and the effectiveness of existing infrastructure and mitigation.

3.3.1 Masses and Volumes Reporting

The IA requires the recording and annual reporting of average monthly and daily tailings volume and mass, mine water, recycled tailings water and freshwater makeup. Data are reported annually in the annual report.

Effluent Treatment Plant (ETP) operation began in May 2018 and continued throughout the remainder of the year apart from brief shutdowns for maintenance. Discharge of treated effluent began on July 20th, 2018 to Scraggy Lake (the receiving environment) via the constructed wetland; a total of 812,250 m³ of treated effluent was discharged to Scraggy Lake in 2018, 1,760,674 m³ was discharged in 2019, and 1,641,669 m³ in 2020. Effluent discharge was not conducted between August and December 2019, and again from June 23 to September 23, 2020, in order to maintain minimum operating levels within the TMF pond for process water recycling use at the Plant. During 2018, 2019 and 2020, a total of 2,109,085; 2,389,004; and 2,785,406, respectively, tonnes of dry tailings were processed through the Mill Facility and deposited in the TMF. A total volume of 2,928,878 m³ of TMF recycle water and 174,784 m³ of fresh water (from Scraggy Lake) was used for Mill Facility operation in 2018. The volumes in 2019 were 2,939,311 m³ of TMF recycle water and 140,811 m³ of fresh water. The volumes were 3,259,054 m³ of TMF recycle water and 139,231 m³ of fresh water in 2020.

Historic tailings and arsenic contaminated soil were deposited in the TMF in 2018 and 2019. AMNS excavated a total of 39,840 tonnes of historic tailings in 2018 and deposited them in the Stage 1 Historic Tailings Containment Cell (HTC1). In 2019, 59,440 tonnes of historic tailings were excavated: 31,240 tonnes were deposited in the HTC1, while 28,200 tonnes were deposited in the Stage 2 Historic Tailings Containment Cell. In addition, 103,370 tonnes of arsenic contaminated soil was removed from these areas and placed in the TMF in 2018, 60,890 tonnes in 2019.

3.3.2 TMF Safety Inspections and Capacity Review

To comply with IA regulatory requirements as well as AMNS internal policies on dam safety, semi-annual dam safety inspections of the TMF are required to be completed by the TMF Engineer of Record. Semi-annual dam safety inspections have been completed as required by the IA. No issues with the overall safety of the Tailings Dam, Polishing Pond Dam, and Wetland Berm have been identified to date, although observations made in 2019 led to 12 recommendations, and observations in 2020 led to 13 recommendations (AMNS 2018, 2019, 2020c, 2021a). Three recommendations made in 2020 are in progress, to be completed in 2021. Recommendations completed following the dam safety inspections include adding rip rap to geobag discharge collection ditch, completion of eastern portion of seepage ditch, monitoring of downstream slope of east TMF dam, repair road materials and grades in emergency spillway, and maintain general site conditions. In progress (2021) recommendations include; localized regrading will be required to direct runoff towards the seepage collection ditch, piezometer cables to be extended as required with dam construction to allow for measurements to be collected from a safer location, and removal of woody debris particularly around the polishing pond intake structure.

In addition to the semi-annual dam safety inspections, semi-annual capacity reviews are also required to be completed by the TMF Engineer of Record. As stated in the most recent capacity review, the current and forecasted capacity of the TMF will retain the projected accumulation of mine tailings and runoff, and the current stage of TMF development complies with design standards (AMNS 2021a).

3.3.3 Independent Tailings Review Board

AMNS contracted an Independent Tailings Review Board (ITRB) in 2019, as per the Mining Association of Canada - 2019 Tailings Management Guide. The ITRB provides independent review of the design, construction, operation, and closure of the Touquoy Mine, specifically focused on the TMF, as it pertains to geotechnical, geochemical and water quality aspects. The Touquoy ITRB consists of three independent tailings management experts performing their review of our facility at minimum once per calendar year. To date the ITRB has not identified areas of non-compliance or conditions which compromise TMF integrity. The ITRB concluded from its 2019 and 2020 reviews that the overall stewardship of the TMF met its expectations of good practice (AMNS 2020c, 2021a).

3.3.4 Surface Water and Groundwater Monitoring

Annual surface water and groundwater monitoring includes monthly and quarterly monitoring results for water quality and quantity in support of the operation of the Touquoy Gold Project. Data from 2016 and 2017 represent baseline conditions. The Approved Project began discharging effluent from a polishing pond via a constructed wetland into Scraggy Lake, with discharge beginning in July 2018. The results of annual monitoring are compared to relevant baseline conditions established in 2016-2017, water quality predictions, and contingency plan action levels. The 2019 and 2020 findings were as follows:

- A depressed groundwater table was observed at OPM-2A/B in 2019 and continued in 2020, and appears to have a minor influence on stream flows in Moose River during low-flow. The original EA predicted there was no anticipated risk of dewatering Moose River into the Open Pit The effect identified in 2019 and 2020 is not attributable to dewatering rates of the Open Pit, and there is no evidence of inflows from Moose River to the Open Pit. This effect is attributed to the interception of groundwater in the Open Pit that would have otherwise discharged to Moose River. An investigation in 2020 determined that the reductions in flow rates in Moose River are greater than the dewatering rates from the Open Pit and therefore cannot be solely attributed to baseflow reductions to Moose River associated with the Open Pit Project-related effects to surface water flows are predicted to be less than 5%; therefore, no adverse effects to the aquatic environment are identified.
- Water quality in Moose River is consistent with background water quality and does not appear to be affected by site operation, as predicted in the original EA.
- Surface water quality above predictions were noted at monitoring stations in Watercourse #4; however, this was also observed in upstream surface water monitoring stations in Watercourse #4, which is not attributed to tailings seepage or mine site effluent. Siltation events in Watercourse #4 from the adjacent TMF Haul Road have, however, required additional erosion and sediment control mitigation to prevent future siltation events. Construction of the redesigned TMF Haul Road is scheduled for Spring 2021 (Stantec 2021a).
- Discharge commenced in July 2018 but ceased July 2019 to March 2019, and June 23 to September 23 in 2020. Results of discharge monitoring indicated concentrations less than the MDMER discharge limits. Although effluent exceeded the Tier I EQS and CCME guidelines for several parameters, it did not exceed the MDMER limits, or impair the downstream water quality in Scraggy Lake samples, as predicted in the original EA with planned operation of the TMF.
- Increasing trends were observed for several indicator parameters (arsenic, cobalt, copper, ammonia, sulphate, conductivity, sodium, and chloride) at various groundwater wells across the site, which trigger additional surveillance activities. All wells were noted to be below action levels, with some exceptions (AMNS 2021a). Increased sulphate trends along the west side of the TMF were investigated further in 2020 with additional characterization work. The source of the elevated sulphate and metals in the southwest corner of the WRSA and the northwest corner of the TMF appear to be due to seepage or contact water from the WRSA. Although water quality associated with sulphate does not exceed any water quality guidelines, it may indicate the potential for other water quality parameters associated with the waste rock runoff or seepage to migrate toward Watercourse #4. Water quality modelling was recommended to be conducted to evaluate the change in water quality in Watercourse #4 that may be associated with continued seepage from the WRSA to Watercourse #4. The original EA predicted that the potential for groundwater contamination from the TMF is low.

Recommendations for improvements to the surface water and groundwater monitoring program, as well as recommendations for increased surveillance, were made based on the results of the 2020 program (AMNS 2021a). Table 3.3 outlines the recommendations, commitments and actions as presented to

NSECC within its response to information requests, dated June 8, 2021, “Response to Information Requested - Industrial Approval Amendment Application #2012-084244-10 - Touquoy Gold Mine”.

Table 3.3 Recommendations, Commitments, and Actions Resulting from Surface Water and Groundwater Monitoring

Recommendation	Discussion/Commitment	Action
Additional monitoring at MW 15	Add wetland monitoring well MW 15, located in Wetland 15. This will be monitored for parameters required by the IA on a quarterly basis. This will provide additional data on the movement of parameters of concern. This monitoring location will be developed in June 2021.	Surface water monitoring is currently undertaken against the criteria required by the IA. These are reported annually, although additional mitigation and actions are taken as required based on the results and trends observed during monitoring. As discussed below, AMNS will discuss with NSECC the benefits and appropriate format of a semi-annual update for the groundwater and surface water monitoring programs.
Additional water quality modelling to evaluate the potential changes over time to water quality in Watercourse # 4.	Based on the elevated concentrations of sulphate, there is a need to understand the potential for other parameters of concern to migrate towards Watercourse # 4 over time. This is because sulphate behaves more conservatively in groundwater and can be transported more quickly than the other parameters of concern. AMNS will conduct geochemical modelling to evaluate the potential for other parameters of concern that may be associated with continued seepage from the WRSA to migrate toward Watercourse No. 4. The modelling will investigate the potential for attenuation along the groundwater flow paths from the WRSA based on available groundwater and water quality data. This work will be undertaken and reported to NSECC by September 2021.	If the water quality modelling demonstrates that water quality impacts from other parameters of concern are likely to occur, develop a remedial action plan to manage seepage that would otherwise impair the water quality in Watercourse #. 4.
Geotechnical Investigations	AMNS is planning to undertake geotechnical investigations at the WRSA to understand if there are opportunities to improve drainage/seepage collection systems. This work will be undertaken and reported to NSECC by September 2021.	If geotechnical investigations demonstrate that improvements can be made with regards to the design or materials used in the WRSA drainage system, these will be reviewed with NSECC.
Aquatic toxicity analysis for sulphate	There are no Nova Scotia – based criteria for sulphate. The British Columbia guideline has been used to contextualize discussions; however, it has not been adopted as a site-specific criterion. An understanding of the potential for elevated sulphate levels to affect aquatic health would be beneficial. AMNS commits to undertaking an evaluation of the potential for effects associated with measured sulphate concentrations in the receiving environment (Watercourse # 4). This work will be undertaken and reported to NSECC in July 2021.	If the evaluation concludes that there is the potential for adverse effects associated with sulphate concentrations, remedial actions will be developed in consultation with NSECC.

Table 3.3 Recommendations, Commitments, and Actions Resulting from Surface Water and Groundwater Monitoring

Recommendation	Discussion/Commitment	Action
Semi-annual Updates for Groundwater and Surface Water Monitoring	The Groundwater Contingency Plan (GWCP) (Stantec 2019a; SD 3) presents tiered contingency action levels for parameters of concern associated with mining activities based on the baseline water quality during operation. Three action levels, established for use at the Touquoy mine site, are increased surveillance, Threshold 1 and Threshold 2 action levels. Groundwater quality results exceeding an action level trigger a range of potential actions as outlined in the GWCP (Stantec 2019a). The GWCP is a robust management tool that is proactive and represents industry standards in adaptive management planning. Although the results of monitoring programs are reported annually, AMNS reviews data in real-time so that appropriate actions are taken in a timely manner. Considering recent discussions with NSECC, AMNS believes there would be a benefit in submitting semi-annual updates for the groundwater and surface water monitoring programs.	AMNS will discuss with NSECC the benefits and appropriate format of a semi-annual update for the groundwater and surface water monitoring programs.

3.3.5 Ambient Air Quality Monitoring

Ambient air quality monitoring for dust (i.e., total suspended particulate (TSP)) is required under the IA in Condition 4c). The IA requirements include annual monitoring (during July and August) at six monitoring stations throughout construction, operation, and reclamation (including periods of facility dormancy). The monitoring is conducted to confirm the original EA prediction that TSP at or beyond the site property boundaries will not exceed 120 $\mu g/m^3$ over a 24-hour averaging period or 70 $\mu g/m^3$ over an annual averaging period.

The 2017 monitoring found eight TSP exceedances out of 38 samples collected over an eight-day sampling period (AMNS 2018). Some of these exceedances may have been biased (high) due to site constraints with sampler placement. Nonetheless, additional mitigation was used starting in 2017, with two additional water trucks added to the mobile fleet, and magnesium chloride was used starting October 2017.

Improvements were noted in 2018, with three TSP exceedances out of 41 samples collected over a seven-day sampling period (AMNS 2019). All three exceedances were from one station located on the mine site, and there were none at sampling stations near or beyond the property boundaries. In addition to the additional mitigation initiated in 2017, a truck sweeper was used to reduce dust re-entrainment along asphalt surfaces.

Monitoring in 2019 resulted in 13 TSP exceedances out of 42 samples collected over the seven-day sampling period (AMNS 2020c). All exceedances were from two locations; one is located near the middle of the mine site adjacent Mooseland Road and the mines haul road crossing, and the other is a background location approximately 1.2 km from the western site boundary. Mooseland Road and Moose River Road were converted from asphalt to gravel in late 2018 which was likely the reason for the background exceedance; repaving was completed in fall 2019 following the monitoring program.

Results of the 2020 ambient air quality monitoring found four TSP exceedances out of 41 samples collected over the seven-day sampling period (AMNS 2021a). The exceedances occurred at two sampling locations (Location 2 and Location 3). Location 2 is situated approximately 100 m west from the Open Pit and Location 3 is situated near the middle of the mine site adjacent to Mooseland Road and the mine haul road crossing. Exceedances found at the two locations were determined to likely be the result of dust being generated from localized sources, such as traffic on the Plant Access Road, haul road, haul road crossing and in the Open Pit area.

Identified exceedances at monitoring stations have typically been linked to monitor placement close to local site sources of dust, with influence from offsite sources (e.g. Mooseland Road, temporary removal of pavement from public roads). Nonetheless, AMNS has improved mitigation to reduce dust on site haul roads and Plant Access Road.

3.3.6 Blasting Monitoring

Blast monitoring for air concussion and ground vibration is required under the IA. Blasting events have been monitored since 2017, usually at two monitoring stations except in the rare case of equipment malfunction or early blasts due to lightning standard safety procedure. To date, recorded parameters fall within the acceptable blasting limits included in the IA for ground vibration (12.5 mm/s) and air concussion (128 dBL)(AMNS 2018, 2019, 2020c, 2021a). There have been no public complaints regarding blasting to date.

3.3.7 Metal Leaching and Acid Rock Drainage Monitoring

Since the commencement of mine operation to the end of 2017, a total of 146 samples of waste rock were submitted for sulphur analyses and a total of 41 samples were submitted for operational acid base accounting (ABA) testing and metals. The median and maximum total sulphur values were 0.19 and 0.69%, respectively, and the minimum net potential ratio (NPR = NP/AP) was 2.46 (where a NPR value of >2 generally indicates non acid-generating). Arsenic is the only metal species that is consistently elevated above 10 times the average upper crustal abundance and shows medium and maximum solid-phase contents of 1630 and 9420 mg/kg, respectively (AMNS 2018).

In 2018, 150 mine rock samples and 23 tailings samples were submitted for ML and ARD analyses. The median and maximum total sulphur values of mine rock samples were 0.28 and 0.88%, while NPR values ranged from 0.8 to 64. Samples with an NPR of <3 underwent shake flask extraction (SFE) testing which produced neutral to alkaline pH values ranging from 7.4 to 9.2 with a median of 7.9; therefore, none of the samples with an NPR of <3 are actively acid-generating. The monitoring data suggest only a small percentage of collected waste rock samples (13%) are PAG (NPR<2); however, 99% of samples have an NPR>1 and therefore the stored waste rock material as a whole generally contains an excess of neutralizing potential and therefore the risk of ARD development is considered low. Two of 23 tailings samples submitted for testing were classified as PAG. Arsenic, being the primary parameter of concern from a water quality perspective, shows a range of 0.010 to 0.9 mg/L with a median of 0.055 mg/L in SFE solution.

In 2019, 141 mine rock samples and 24 tailings samples were submitted for ML and ARD testing. The median and maximum total Sulphur values of mine rock samples were 0.28 and 1.3%, while NPR values ranged from 0.74 to 59. SFE tests on 100 rock samples produced neutral to alkaline pH values ranging from 7.5 to 9.4 with a median of 7.9, consistent with values reported for 2017-2018, and confirms none of the samples with an NPR<3 are actively acid generating. Twelve of the 24 tailings samples (50%) are classified as PAG with an NPR<2; however, none of the tailings samples were found to have an NPR < 1 and therefore modified NP exceeds AP in all samples tested. Although a considerable proportion of tailings samples showed NPR values below 2, no tailings sample was conclusively identified as PAG by the single-addition NAG test. Arsenic shows a range from 0.0086 to 0.4 mg/L with a median 0.072 mg/L in SFE solutions.

In 2020, 189 mine rock samples and 55 tailings samples were submitted for ML and ARD analyses. The median and maximum total sulphur values of mine rock samples were 0.23 and 1.3%, while NPR values ranged from 0.55 to 157. Samples with an NPR of <3 underwent shake flask extraction (SFE) testing which produced neutral to alkaline pH values ranging from 7.6 to 9.2 with a median of 8.5; therefore, none of the samples with an NPR of <3 are actively acid-generating. The monitoring data suggest 16% of collected waste rock samples are PAG (NPR<2); this is a lower percentage than observed in previous years. Eleven of 55 tailings samples (20%) submitted for testing were classified as PAG. No tailings sample was found to have an NPR <1 and therefore modified NP exceeds AP in all samples tested. The results of these analyses continue to be consistent with initial pre-operational testing results that indicate low potential of waste rock to generate ARD. Arsenic shows a range from 0.0036 to 0.71 mg/L with a median 0.056 mg/L in SFE solutions. This median is lower than calculated for the 2019 database.

Overall, given that the materials generally contain an excess in neutralization potential (NP), the risk of ARD development in the Touquoy WRSA is considered relatively low, which is consistent with the predictions of the original EA. Given the fine particle size of tailings allowing for NP liberation, the generally well-mixed nature of tailings slurries, as well as mostly subaqueous deposition, the risk for ARD development in the TMF is considered to be very low despite the increase in PAG proportion in 2019 compared to 2017-2018 and 2020 (AMNS 2019, 2020c, 2021a).

AMNS initiated weekly pH testing of water from the Open Pit in January 2017, and results have been relatively consistent. Results in 2017 showed an alkaline pH averaging 7.82, and the 95th percentile of results between 7.44 and 8.23. The mean and median pH in 2018 were 7.84 and 7.88, respectively. In 2019, results were similar, with a mean of 7.77 and median of 7.70. Results from 2020 are slightly lower with mean and median values of 7.45 and 7.39, respectively.

Weekly monitoring of pH in the waste rock collection ponds began in July 2018. Water in these ponds is alkaline, with an average pH of 7.97 in 2018, 7.79 in 2019 and 7.52 in 2020.

3.3.8 Wetland Monitoring

Wetland alteration activities are expected to occur throughout the mine's development. AMNS has received approval from NSECC to alter 58.86 ha of wetland associated with the Touquoy Gold Project. The Water Approval for Wetland Alteration (#2016-095967-04) required the development of a Wetland Monitoring Plan; associated baseline monitoring was completed in 2016 prior to construction. Post-construction wetland monitoring is required of remaining unaltered wetland habitat, which has occurred annually since July 2017. The monitoring is intended to determine whether areas of unaltered habitat remain viable and present healthy wetland characteristics. As of the 2020 monitoring, a total of 48.61 ha (82.6%) of the 58.86 ha permitted areas has been altered, including 47.50 ha directly altered and 1.11 ha indirectly altered (MEL 2021a).

In Year 3 (2019) and Year 4 (2020) detailed vegetation and hydrology assessments were evaluated in combination with the completion of general assessments at the baseline locations within the remaining unaltered wetland habitat, along with additional monitoring locations incorporated in 2018. Observations of baseline locations did not indicate a hydrological change. No invasive plant species were observed at detailed or general vegetation observation locations. Vegetation remains hydrophytic in all monitored wetlands and was not observed to be stressed (MEL 2021a,c). Detailed vegetation assessments indicated only minor vegetative community changes in dominant species composition since baseline, which may be explained by seasonal effects and observer bias (MEL 2021a,c). However, there is one wetland where a predicted effect (a reduction in surface hydrology resulting in a potential change in wetland functionality) from the Touquoy operation has been identified (WL22). These observed potential changes are expected to be as a result of Open Pit operation (groundwater drawdown). This change is being analyzed and documented, and discussions are ongoing relating to additional compensation requirements with NSECC.

Ongoing monitoring has been effective at tracking unanticipated impacts from the Approved Project, requiring additional permitting and associated wetland habitat compensation. While the total approved area of wetland alteration is greater than initially identified in the original EA due to ongoing changes in project design and further wetland delineation of wetlands for wetland alteration permitting, no significant habitat loss has been identified, and the principle of minimization of impacts is still applied, all wetland habitat loss is being compensated, and mine site reclamation mitigation measures will also be applied upon project completion. Unintended wetland alteration has occurred; however, this has been relatively small, has been addressed by implementation of corrective actions, and is being captured during annual wetland monitoring, and covered under alteration amendments and compensation requirements.

3.3.9 Environmental Effects Monitoring

EEM consists of effluent and water quality monitoring studies and biological monitoring studies (SD 12). Baseline data collection for the EEM was completed in 2017 and 2018. The Phase 1 EEM study design was submitted to ECCC in July 2019, within 12 months of the mine becoming subject to MDMER, as required. Biological sampling for the Phase 1 EEM was completed in Fall, 2020, and the Phase 1 EEM Interpretive Report is due July 20, 2021.

Effluent characterization was conducted quarterly in 2020. Sublethal toxicity testing of effluent samples is generally conducted twice a year since the mine became subject to the MDMER in July 2018 with exceptions as reported to ECCC. Water quality monitoring is conducted four times per year and at least one month apart in both exposure (Scraggy Lake) and reference (Long Lake) areas selected in the biological monitoring program, with exceptions as reported to ECCC. Biological sampling completed in 2020 included:

- Fish population survey using white sucker and yellow perch as sentinel species
- Fish tissue study
- Benthic Invertebrate Community Study

Information on supporting environmental variables was collected to aid in the interpretation of the fish and benthic invertebrate community data. Both in situ data and water samples were collected from near surface. A sediment sample was collected from each area simultaneously with benthic invertebrate collection.

Effluent and water quality are characterized four times a year for a suite of parameters in accordance with MDMER Schedule 5 Part 1. Effluent met the authorized MDMER Schedule 4 limits, maximum monthly mean concentration, or maximum concentration in a grab sample in 2018, 2019 and 2020. There were no acute toxicity failures in any of the reported years for rainbow trout and Daphnia magna; however, there was one acute toxicity failure in 2021 related to ammonia (Stantec 2021e). During Phase 1 EEM (2018 to 2020) for sublethal testing, fathead minnow and algae (*Pseudokirchneriella subcapitata*) were the least sensitive to mine effluent. The more sensitive species were macrophyte plants and invertebrates, with both often exhibiting sublethal effects from effluent samples in Phase 1 of the EEM program.

Preliminary results of biological monitoring from the Phase 1 EEM are summarized below.

For the Phase 1 fish population survey, there were differences in a few of the effect indicators measured for male and female white sucker within the exposure area, but they were below thresholds that would be indicative of higher risk to the environment. Observed differences in fish endpoints may reflect differences in environmental factors (i.e., habitat, food availability, competition) within lakes and or basins. For mature male and female yellow perch there were also differences in a few of the effect indicators in the exposure area compared with reference areas, but the direction of effects was not always consistent for each reference area, suggesting that these differences reflect differences in environmental factors within lakes and basins. For female yellow perch, where the effect and direction were consistent when compared to reference areas, the effect was below a threshold that would indicative of higher risk to the environment.

For the benthic invertebrate community there were no differences in taxa richness and evenness between exposure and reference areas. There were differences in community composition (similarity) between the exposure and reference areas and a difference in density between the exposure area and one of the reference areas. Differences in community composition (similarity) and density were also noted between references areas, which suggests that the observed differences reflect differences in environmental factors within lakes and basins. Overall, there is limited evidence to suggest an effect of the mine on the benthic invertebrate community in Phase 1.

Phase 1 EEM results support the predictions of the original EA. Phase 2 EEM biological studies will be conducted in 2023 or earlier and will be used to confirm results observed in Phase 1.

3.3.10 Mainland Moose Monitoring

Evidence of mainland moose (*Alces alces americana*, NS ESA Endangered), was observed during baseline surveys completed in 2004 and 2005 for the 2007 EARD More recently, moose surveys have been completed as part of the Touquoy Gold Project Mainland Moose Management Plan (MMMP) (2017). To date, three observations of mainland moose signs (scat and tracks) were observed during 2017 surveys, and two sightings of moose tracks were observed during 2018 surveys. These observations were approximately 2 to 4 km from the mine site. No sign of moose were observed during 2019, 2020 and 2021 surveys. However, an incidental observation of a moose on a road near the Touquoy Mine Site was reported by AMNS staff in 2019 and local residences reported moose observations in the vicinity of the Mine Site, along Mooseland Road, in 2020.

4.0 ENGAGEMENT

AMNS recognizes that effective communication and engagement with Indigenous communities, the public, stakeholders, and regulatory agencies is a key component of a successful project and an effective EA. AMNS has engaged directly with the Mi'kmaq of Nova Scotia on a community basis and through dialogue with the Kwilmu'kw Maw-Klusuaqn Negotiation Office (KMKNO), has had a CLC in place since 2011, and has undertaken "One-Window" meetings with provincial and federal regulators.

As part of ongoing communication with the Mi'kmaq of Nova Scotia, the CLC and regulatory agencies on the Approved Project, AMNS introduced the proposed modifications to the Approved Project in 2020. AMNS was planning to seek regulatory approval of the modifications through an amendment to their existing IA (#2012-084244-08) and in December 2020, an application for an IA amendment was submitted to NSECC. At that time, the proposed modifications included an expansion of the existing TMF and did not include in-pit tailings disposal. Since the Ministers determination that an EA Registration is required to assess the proposed modifications before the IA can be amended, AMNS has withdrawn the proposed TMF expansion from the list of proposed modifications in favour of a longer-term solution provided by in-pit disposal.

This section describes engagement efforts taken by AMNS which are directly relevant to the proposed modifications, as well as feedback received from the Mi'kmaq of Nova Scotia, the community, and regulatory agencies. Although the TMF expansion is no longer part of the Project to be assessed, comments pertaining to the existing TMF operation are included below as relevant.

4.1 INDIGENOUS ENGAGEMENT

AMNS has maintained an open dialogue with the Mi'kmaq of Nova Scotia, specifically with the Assembly of Nova Scotia Mi'kmaq Chiefs via the KMKNO. In addition to engagement efforts with the KMKNO, AMNS has continued to directly engage with the Millbrook First Nation and is continuing efforts to open a dialogue with the Sipekne'katik First Nation. These First Nations represent the closest Mi'kmaq communities to the Touquoy Gold Project and both First Nations represent themselves in consultation and negotiation matters outside the KMKNO process. Indian Brook Reserve No. 14 associated with Sipekne'katik First Nation is 42 km from the Touquoy Mine Site; Bear Lake Reserve No. 17 and Sheet Harbour Reserve No. 36, both associated with the Millbrook First Nation are approximately 13 km and 29km, respectively from the Mine Site.

Engagements pertaining to the Project began in the summer of 2020 with a focus on the proposed modifications of the WRSA and TMF IA amendment application. Engagement efforts are ongoing and have focused on the proposed modifications included in the scope of this EARD.

Meetings with the Millbrook First Nation and KMKNO about the IA amendment application occurred on March 21, 2020 and July 14, 2020. On December 15, 2020 project modifications were discussed as a part of a larger presentation to KMKNO, the NS Office of L'nu Affairs (NSOLA; formerly Office of Aboriginal Affairs, Pictou Landing First Nation and Paq'tnkek First Nation.

Meetings with the Millbrook First Nation and KMKNO about the 2021 EA Registration occurred on March 16, March 26, and April 8, 2021.

A summary of concerns and responses raised by Indigenous communities is presented in Table 4.1.

Table 4.1 Summary of Indigenous Comments

Question/Issue/Concern	AMNS Response	EA Registration Reference
Potential impacts or changes in surface water quality in lakes and streams	Site water is managed to a single point of discharge, where possible. Water is treated prior to discharge when necessary, and, that a robust monitoring program is in place to confirm water quality. This program is open to Indigenous participation including Environmental effects monitoring in receiving waters.	Section 7.0, Surface Water Resources
Potential impacts to fish and fish habitat	No impacts are predicted that that the already robust monitoring program currently in place will be updated.	Section 8.0, Fish and Fish Habitat
Dust from operations impacting traditional practices	Dust suppression strategies are employed on site and are functioning well and that no changes to dust are anticipated. AMNS also mentioned that the existing monitoring program will be updated.	Section 5.0, EA Scope and Methods
Elevated levels of noise and light impacting hunting near the mine	No increase in noise or light levels are expected.	Section 5.0, EA Scope and Methods
Loss of traditional species habitat and loss of access for traditional purposes	The proposed modifications include an increase in mine footprint of 7 ha which represents an overall 3% increase. The area to be impacted has previously been assessed for ecological value and cultural resources and are updated in the EARD	Previous EA (CRA 2007a) and Section 10.0 Cultural and Heritage Resources
TMF safety and stability	No expansion of the current TMF is planned and that deposition of current tailings into the open pit is considered a safe method of tailings disposal. AMNS has stated that the existing monitoring plan will address long term surface and groundwater quality.	Section 3.0, Environmental Management and Monitoring
Site management during closure and reclamation	Reclamation bonds will support long term monitoring and remediation efforts are financed by the company. AMNS has invited Millbrook to participate in a Reclamation Working Group being formed for the Touquoy operation.	Section 2.0, Project Description
Mine water management, treatment, and discharge	AMNS described the function of onsite water management including the stages of TMF, the duration of water retention and the monitoring of discharge flows.	Section 7.0, Surface Water Resources

Table 4.1 Summary of Indigenous Comments

Question/Issue/Concern	AMNS Response	EA Registration Reference
Indigenous employment and community benefits	AMNS will continue to identify opportunities for improvement by working with the human resources teams from indigenous communities.	na
Impacts to cultural resources and the role of archaeology	AMNS described the various levels of screening and surveying undertaken and detailed the stipulations in the environmental protection and the reporting requirements associated with an archaeological discovery on site.	Previous EA (CRA 2007a) and Section 10.0 Cultural and Heritage Resources
The necessity and role of a TMF	AMNS described the functions and stages of the TMF while also discussing alternatives including in-pit tailings deposition.	Section 2.0, Project Description
Potential risks and mitigation strategies related to in pit tailings storage	AMNS responded that in-pit tailings disposal is a safe and effective tailings deposition strategy and that there is an extensive monitoring system.	Section 2.0, Project Description and Section6.0, Groundwater Resources

4.2 COMMUNITY ENGAGEMENT

St. Barbara, the parent company of AMNS, maintains a community relations policy that supports company efforts to engage with and maintain a productive dialogue with the citizens of Nova Scotia and the communities surrounding the Touquoy Mine Site. The key pillars of the community relations policy are:

- Engaging in positive and timely communication in an open and transparent way with all stakeholders including governments, local communities, employees, contractors, and regulatory authorities.
- Encouraging all personnel including employees, contractors, and consultants to demonstrate respect for local communities and their cultural values, traditions, and beliefs.
- Supporting the implementation of processes to educate employees who are working in communities about cultural awareness and encouraging them to be proactive and transparent in engagement processes.
- Seeking to increase the positive impact of St. Barbara's operations on local economies through employment and training opportunities and the development of local businesses.
- Conducting of operations and interactions with local communities in a manner consistent with recognized principles of security and human rights.

Supported by community relations policies, AMNS has continually sought engagement with numerous communities through the CLC. AMNS publishes regular updates through newsletters and bulletins.

4.2.1 Public Engagement

In March 2020, AMNS conducted public opinion research to gauge the opinions of Nova Scotians on the gold mining industry (AMNS 2020a). A random selection of 700 Nova Scotians over the age of eighteen were surveyed by telephone. The sample was weighted by age, region, and gender to provide an accurate representation of the provincial population. Respondents included 338 individuals from Pictou County, Antigonish County and Guysborough County, 155 from the Halifax Regional Municipality, 66 from Cape Breton, and 479 from other mainland communities. Key findings included that seventy-five percent of those surveyed support gold mining with support being slightly higher at eighty percent in communities of interest (i.e., Pictou, Antigonish and Guysborough counties). Respondents cited that the creation of jobs and contributions to the provincial economy were the main reasons for their support. A summary of findings is attached (AMNS 2020a, Appendix B.1).

On May 31, 2021 a webinar was held to update public stakeholders on the proposed Project modifications. Attendees included 20 individual representatives from the Sheet Harbour and Area Chamber of Commerce, the Ecology Action Centre, the Moose River Gold Mines Museum Society, Sustainable Northern Nova Scotia, Maritime Aboriginal Peoples Council, Save Caribou, Icelandic Memorial Society of Nova Scotia as well as residents from the local community.

A summary of questions and concerns raised during the community stakeholder webinar which relate to the current Project presented in Table 4.2 with a full report including attendees and questions available in Appendix B.3.

Table 4.2 Summary of Stakeholder Concerns Raised During May 2021 Webinar

Question/Issue/Concern	AMNS Response	EA Registration Reference
Process questions: • **Federal EA** • **Modifications not included in original assessment** • **Relationship to other sites**	• Proposed modifications to the Touquoy Gold Project do not meet the thresholds to trigger a federal assessment process which are linked to a certain increase in mining area, production capacity or input capacity. • The project continues to change and evolve; new modifications represent ways to improve safety and efficiency on site. • Modifications are neither linked nor driven by any other projects and are strictly related to Touquoy.	Section 1.0, Introduction Section 5.0, EA Scope and Methods

Table 4.2 Summary of Stakeholder Concerns Raised During May 2021 Webinar

Question/Issue/Concern	AMNS Response	EA Registration Reference
Water quality concerns: • **Arsenic** • **Scraggy Lake** • **Increase in sedimentation from Clay Borrow Area** • **Pit lake toxicity**	• The Project will not create the conditions in which arsenic would pose an increased risk. • AMNS is undertaking modelling to confirm the proper design and engineering is in place. Water in Scraggy Lake will meet applicable regulatory standards. • Water management plans for the Touquoy Mine Site will be updated as required to incorporate engineering design of drainage and water treatment infrastructure to avoid adverse effects on water quality. • Water quality in the pit-lake will be monitored and no water will be released from the Open Pit before it meets regulatory requirements/standards.	Section 6.0, Groundwater Resources Section 7.0, Surface Water Resources
Project Description questions • **Mine life** • **Traffic** • **Tailings** • **PFAS Chemicals**	• The modifications will allow AMNS to continue operating the mine but will not extend the life of the mine. • the Project will not cause increased traffic. The relocation of the Plant Access Road will improve operational safety and efficiency. • Mine tailings are the waste materials that are generated from the processing of low and medium grade Touquoy ore. They are comprised of crushed rock and process effluents and form a slurry that is currently deposited in the TMF. AMNS is currently seeking approval to deposit mine tailings in the exhausted Open Pit. • PFAS chemicals are not used	Section 2.0, Project Description
Interactions with Mainland Moose	These are considered in the EA. Monitoring has been ongoing since 2017. Public sightings are an important aspect of monitoring and reports of sightings are integrated to annual reports.	Section 9.0, Terrestrial Environment
Land ownership: • **Crown land** • **Private land required for the Modifications**	• AMNS will be applying for a lease of a small amount crown land. • No private land is required for the modifications.	Section 2.0, Project Description
Project benefits	The Project will benefit local communities and the province by continuing to provide full time jobs for and by creating partnership opportunities.	Section 1.0, Introduction

Table 4.2 Summary of Stakeholder Concerns Raised During May 2021 Webinar

Question/Issue/Concern	AMNS Response	EA Registration Reference
Interactions with cultural and heritage resources	Archaeological surveys have been conducted resulting in no cultural or heritage resources being discovered. If resources are incidentally discovered during Project activities, contingency protocols are in place.	Section 10.0, Cultural and Heritage Resources

4.2.2 Community Liaison Committee

AMNS supports and participates in the ongoing CLC meetings. The CLC was established in 2011 with a mandate to facilitate discussion and sharing of information in an equitable forum between the community and AMNS on matters regarding Project design, permitting, site preparation, operation, and decommissioning and reclamation activities. AMNS provides updates on site activities, employment, the regulatory environment, and on all safety non-compliance issues recorded during the previous quarter. Recommendations made to AMNS by the CLC are formally considered and responded to by AMNS.

The CLC is designed to host between 6-10 members from local communities including Mooseland, Middle Musquodoboit, Upper Musquodoboit, Sheet Harbour, Tangier and Musquodoboit Harbour. The CLC generally meets on a quarterly basis.

In 2020, the CLC met in January, November, and December, with the regular frequency of quarterly meetings interrupted by the COVID-19 pandemic. The CLC meeting held by teleconference on December 22, 2020 focused on the IA amendment application including the WRSA expansion and TMF raise (note the TMF raise is no longer included in the scope of modifications addressed in this EARD A subsequent CLC meeting on March 13, 2021 further explored the proposed modifications that are now part of this EARD.

Concerns raised by the CLC regarding Touquoy site modification are summarized below in Table 4.3. AMNS has proactively taken steps to address the concerns and questions from the CLC during the meetings; however, a standing offer also exists to provide more information if requested.

Table 4.3 Summary of Comments from the CLC

Question/Issue/Concern	AMNS Response	EA Registration Reference
Request for more local community engagement	AMNS held a local open house meeting was held on October 22, 2019 at the social club, located on Moose River Road in Mooseland. During the meeting AMNS provided a short presentation on the mine and answered questions presented by those in attendance.	Not applicable

Table 4.3 Summary of Comments from the CLC

Question/Issue/Concern	AMNS Response	EA Registration Reference
Dam stability	AMNS provided information on the integrity of the TMF design, stability analyses and on the quality control that is a part of the ongoing construction overseen by an Engineer of Record and the ITRB. AMNS further offered to organize a meeting that would include presentations and Q&A from the Engineer of Record and the lead member of the ITRB.	The TMF dam is not part of this assessment; using the Open Pit for tailings deposition is discussed in Section 2.2.2.
Downstream water quality related to TMF and WRSA	AMNS provided an update for water and effluent management for these facilities and the required setbacks from the watercourses.	Water quality is assessed in Section 6, and 7.

In addition to issues that have been raised through the CLC, AMNS is also sometimes contacted directly about community issues and concerns. Ongoing concerns raised regarding the Approved Project have primarily pertained to an increase in local traffic, alleged vehicle damage and alleged speeding incidents. In 2020, AMNS received four new community complaints. Two regarding road conditions at the haul road crossing and Mooseland Road. Another complaint, received during a public engagement included concerns about the use of remote cameras, the lack of an ATV bypass trail and the location of the silt curtain in Scraggy Lake. The final complaint was in relation to sediment entering an off-site watercourse near a contractor clay excavation site. AMNS follows its Complaint Resolution Procedure to successfully resolve community complaints (Section 4.4). As part of regulator CLC meetings, AMNS shares reports of community complaints as well as actions taken by AMNS to address concerns.

4.3 REGULATORY ENGAGEMENT

AMNS has maintained an open dialogue with provincial regulators and has used the One-Window process facilitated by NS DEM that includes relevant provincial and federal regulatory agencies. Meetings to discuss the proposed modifications to the Approved Project occurred on November 19, 2020 and December 9, 2020. At that time, AMNS was planning for the submission of an application for amendment to their existing IA to permit the proposed modifications to the Approved Project. AMNS submitted an application for IA amendment on December 23, 2020 and received comments from regulatory reviewers as well as a determination from the Minister of Environment that a Class I EA Registration would be required to assess the proposed modifications before the existing IA could be amended.

Since the Ministers determination that an EA Registration is required, AMNS has met with provincial and federal regulatory agencies to address questions and concerns about the proposed modifications and confirm EA scoping assumptions.

Questions, issues, and concerns that have been raised during regulatory engagement with respect to the proposed modifications generally relate to:

- the effectiveness and overall environmental performance of existing infrastructure (e.g., WRSA, water management infrastructure) for the Approved Project
- the use of monitoring program results to validate predictive modelling and inform the effects assessment
- potential changes to existing monitoring programs to accommodate the proposed modifications
- long-term geochemical changes in groundwater and surface water including post-closure
- impacts to wetlands, surface water, and fish and fish habitat, including potential indirect impacts associated with a reduction in catchment area
- potential impacts on Ship Harbour Long Lake Wilderness Area

In addition to engagement with environmental regulatory agencies, AMNS also met with local member of legislative assembly (MLA) Lloyd Hines, MLA Larry Harrison and Halifax Regional Municipality councilors David Hendsbeee and Cathy Deagle-Gammon. Additionally, on April 7, 2021 AMNS met with representatives from NSOLA and NSECC to discuss AMNS' plans for Indigenous engagement on the proposed modifications. During that meeting NSOLA confirmed consultation and engagement and the assessment of adverse impacts to Mi'kmaq rights relative to this EARD should focus on the proposed modifications, not the Touquoy Gold Project as a whole since the current operation was assessed as part of the Approved Project**.**

4.4 COMPLAINT RESOLUTION PROCEDURE

In support of requirements outlined in Section 21 of the Touquoy Gold Project IA, AMNS has developed a complaint resolution procedure.

The document has been developed to standardize the formal response procedure to complaints from members of the community received directly by AMNS in association with its activities at the Touquoy Gold Project. The plan also standardizes how AMNS receives, records, and investigates complaints, and how submissions of records are made to NSECC.

With this procedure in place, AMNS is committed to addressing complaints in a timely and respectful manner by undertaking the following commitments:

- to receive and record all complaints and document name, title, address, telephone number and email as provided by individual
- investigate the cause of the complaint and undertake appropriate action, if necessary, to correct the problem
- respond to complainant in a timely fashion depending on nature of investigation and correction actions if necessary
- document any corrective actions in short or long term and responses to the complainant, including any arbitration refers, proceedings of referrals and decisions rendered

Once complaints have been received and processed reporting will be completed to NSECC as per IA conditions at a minimum (i.e., quarterly reports); however, notification will be provided as appropriate depending on the sensitivity of the complaint.

5.0 ENVIRONMENTAL ASSESSMENT SCOPE AND METHODS

5.1 OVERVIEW OF METHODS

The approach for this environmental effects assessment is based on methods developed by Stantec to fulfill requirements of an EARD for a Class I Undertaking under the Nova Scotia *Environmental Regulations*.

The scope of assessment and general EA approach was developed in consideration of the following:

- proposed Project components and activities
- knowledge of the existing conditions and interactions with existing mining operation
- previous EA documents prepared for the Touquoy Gold Project (e.g., CRA 2007a, 2007b)
- Environmental Impact Statements prepared for the Beaver Dam Mine Project (GHD 2017) and Fifteen Mile Stream Gold Project (AMNS 2021b) as similar projects proposed by the same proponent in the same region
- applicable regulations, policies, and guidelines
- issues raised during consultation and engagement
- professional experience and expertise of AMNS and its consultants

The approach assumes a precautionary, conservative approach with assumptions generally applied to overestimate potential adverse effects.

The assessment focuses on Valued Components (VCs). VCs are biophysical and/or socio-economic environments that, if altered by the Project, may be of concern to regulatory agencies, the Mi’kmaq of Nova Scotia scientists, and/or the general public. For each VC, potential effects and effect pathways are described, along with measurable parameters to help assess potential effects. Spatial and temporal boundaries are established for the assessment to provide context for baseline conditions and predicted effects. Baseline conditions are described for each VC, drawing on studies conducted to support the EARD and Focus Report for the Touquoy Gold Project (CRA 2007a, 2007b), results of monitoring programs conducted for the Touquoy Gold Project as summarized in annual monitoring reports and, as applicable, new desktop studies and field programs conducted to specifically inform the planning, design, and assessment of proposed Project components.

Potential interactions between the Project and VCs are then identified. Based on an understanding of potential interactions, mitigation measures are proposed to reduce the likelihood and magnitude of potential adverse effects that could arise from these potential interactions. Residual effects (i.e., after mitigation has been applied) of the Project are then analyzed and characterized by standard descriptors considering the direction, magnitude, geographic extent, duration, frequency, and reversibility of predicted effects. The significance of these residual effects is determined against pre-established criteria. Where there may be data gaps or some uncertainty around an effects prediction or effectiveness of proposed mitigation, follow-up and monitoring is proposed.

5.2 SCOPE OF THE ASSESSMENT

5.2.1 Scope of the Project

The Scope of the Project to be assessed is defined as specific modifications that are being proposed at the Mine Site for the Touquoy Gold Project. These modifications are:

- in-pit disposal of tailings
- expansion of the WRSA
- expansion of the Clay Borrow Area
- relocation of the Plant Access Road

The Scope of the Project also includes ancillary components associated with these modifications including improvements to water management infrastructure (e.g., ditching, drainage), relocation of a groundwater monitoring well (WRW-1A/B), and modifications to signage, gates, security shack and the Plant Site parking lot.

The scope of the Project to be assessed does not include current operation and infrastructure of the Approved Project which are not associated with the proposed modifications, nor does it include the use of the Touquoy Mine Site for AMNS satellite mining operations. Use of the Touquoy Mine Site infrastructure for processing ore from Beaver Dam and Fifteen Mile Stream Gold Projects and disposal of associated tailings is assessed in the environmental assessment documents for those projects (e.g., GHD 2017; AMNS 2021b). These projects are considered in the context of Other Undertakings in the Area (Section 11.0).

5.2.2 Selection of Valued Components

Table 5.1 presents a preliminary issues screening exercise using potential Project-environment interactions to identify appropriate VCs upon which the EARD will be focused.

Table 5.1 Selection of Valued Components

Candidate Valued Component	Scoping Considerations	Recommendation for Assessment
Atmospheric Resources (Air, Noise, Light)	Construction will result in the temporary release of particulate and combustion emissions, noise and artificial lighting associated with construction equipment. No changes to existing air, noise or light emissions are predicted for operation. Predicted air, noise and light emissions will be consistent with those identified for the Project as previously assessed. Greenhouse gases from vehicle emissions will be managed according to the GHG Management Plan. Dust will be mitigated by implementing the Fugitive Dust Control Plan for the Touquoy Gold Project (Appendix 5 of the Air Quality Management Plan). Ambient air quality monitoring will continue to be conducted annually in accordance with IA Approval (#2012-084244-08) requirements for the Approved Project. No new mitigation or monitoring is required.	Further assessment as a VC is not required. Atmospheric emissions are discussed in Section 2.4.
Topography, Geology and Soils	Project activities will include intrusive work impacting the topography, geology, and soils within the Touquoy Mine Site. These features are not valued components, but interactions with these features may impact groundwater, surface water and fish and fish habitat and therefore need to be managed. Earthworks and erosion and sediment control measures are discussed in the EPP for the Touquoy Gold Project (SD 1).	Further assessment as a VC is not required. Interactions are addressed as applicable through Groundwater Resources, Surface Water Resources and Fish and Fish Habitat.
Groundwater Resources	Groundwater has potential to be a source of potable water, is important in maintaining ecological habitats by supporting stream flow, vegetation, and wetlands, and is of cultural importance. Project activities will interact with groundwater resources. At different times of the Project (i.e., depending on pit water levels), groundwater will flow into or seep out of the Open Pit, potentially affecting groundwater quantity and quality. Expansion of the WRSA will change the catchment area and may cause changes to seepage from the WRSA to groundwater. Operation of the Clay Borrow Area has potential to lower the groundwater table locally within the footprint of the Clay Borrow Area. Changes in groundwater quality and quantity may result in changes to surface water resources.	Groundwater Resources has been selected as a VC for further assessment.
Surface Water Resources	Surface water is an integral part of the local environment, providing habitat for fish, vegetation, and aquatic populations, and contributing to local socio-economic drivers. Project activities could affect surface water quality through effluent releases, surface water runoff and process water management, and could also potentially result in changes to hydrological or hydrometric conditions in aquatic ecosystems. The Project will also require modifications to existing or installation of new surface water management features.	Surface Water Resources has been selected as a VC for further assessment.

Table 5.1 Selection of Valued Components

Candidate Valued Component	Scoping Considerations	Recommendation for Assessment
Fish and Fish Habitat	Fish and fish habitat provides ecological, cultural, recreational, and economic value to the public, Mi'kmaq people, local businesses, and government agencies. Fish and fish habitat is also protected by provincial and federal legislation. Fish and fish habitat may be affected by Project activities through changes in groundwater and surface water resources.	Fish and Fish Habitat has been selected as a VC for further assessment.
Wetlands	Wetlands are valued resources, protected by the Nova Scotia *Environment Act*. Project activities have the potential to directly or indirectly affect wetland habitat within the Mine Site. Expansion of the WRSA will require alteration of wetland habitat within the Mine Site not previously permitted for alteration.	Interactions with wetlands are assessed under the Terrestrial Environment VC.
Vegetation	Project activities could potentially affect vegetation including species at risk (SAR) or of conservation concern (SOCC) and potentially affect species biodiversity, unique species assemblages, and uncommon habitats. SAR are protected under SARA and the provincial ESA. The WRSA expansion, Clay Borrow Area expansion and relocation of the Plant Access Road will result in new disturbance to terrestrial environment s including lichen SOCI.	Vegetation interactions (with a focus on SAR/SOCC) are assessed under the Terrestrial Environment VC.
Wildlife (Mammals, Birds, Herpetiles)	Project activities could potentially directly or indirectly affect wildlife and their habitat including SAR and/or SOCC. Protection of species biodiversity is administered through SARA, the ESA, and Nova Scotia *Wildlife Act*. In additional protection of migratory birds is mandated by the *Migratory Birds Convention Act, 1994*. Project effects on wildlife would be very limited given that Project activities are occurring within the boundaries of an existing operating mine and there are no identified areas of defined wildlife habitat that will be affected by the proposed modifications. There are also no known incidences of wildlife SAR/SOCC at the Touquoy Mine Site.	Wildlife interactions (with a focus on SAR/SOCC) are assessed under the Terrestrial Environment VC.
Indigenous Peoples	The nearest Mi'kmaq communities to the Project are Millbrook First Nation and Sipekne'katik First Nation. A Mi'kmaq Knowledge Study (MKS) was conducted for the Touquoy Gold Project in 2005 (CMM 2005). The MKS identified several plant species of significance to the Mi'kmaq within the study area and surrounding area but considered potential loss of some specimens as not likely significant given their prevalence in surrounding areas not impacted by the Touquoy Gold Project (CMM 2005). The MKS also highlighted the potential for impacts on Mi'kmaq archaeological resources given the considerable historic Mi'kmaq use and occupation in the study area including the Touquoy Mine Site (CMM 2005). The MKS stated the disturbance of these resources would be significant and recommended a stop work and notification procedure should Mi'kmaq archaeological deposits be encountered during construction or operation of the Touquoy Gold Project (CMM 2005).	Further assessment as a VC is not required. Potential interactions with cultural and heritage resources are assessed under the Cultural and Heritage Resources VC (Section 10.0). Section 4.1 provides details on Indigenous engagement including issues and concerns that have been

Table 5.1 Selection of Valued Components

Candidate Valued Component	Scoping Considerations	Recommendation for Assessment
	The Project is located within the boundaries of the previously assessed Touquoy Mine Site. Given the industrial nature of the site and current mining operation, it is unlikely that Mi'kmaq use of the Mine Site has changed since the MEKS was conducted in 2005. In the unlikely event that archaeological resources are encountered during Project activities, all work will be halted and immediate contact will be made with Special Places Program. If finds are of a Mi'kmaq context, the KMKNO (https://mikmaqrights.com/), the Confederacy of Mainland Mi'kmaq (CMM) (http://cmmns.com/), or the nearest Mi'kmaq community will be contacted. AMNS will continue to engage Sipekne'katik First Nation and Millbrook First Nation directly and other Mi'kmaq communities collectively through the KMKNO in order to provide updates on the Touquoy Gold Project including proposed modifications, understand potential issues and concerns, and address these concerns accordingly.	raised and how these are being addressed.
Cultural and Heritage Resources	Project activities will include ground disturbance that could affect subsurface cultural or heritages resources that may be present. Archaeological resource impact assessments (ARIAs) (CRM Group 2005, 2006) and a Mi'kmaq Knowledge Study (Mi'kmaq Environmental Services 2005) were conducted during the EA process for the Touquoy Gold Project. The study area was determined to have low archaeological potential. The Touquoy Gold Project was not considered likely to have significant adverse effects on archeological and historical features in the area, although it was recommended that no ground disturbance occur within 50 m of Moose River or Square Lake without prior sub-surface testing. A portion of the WRSA expansion will impinge on the 50 m buffer of Square Lake and a portion of the Clay Borrow Area expansion lies outside the study areas assessed and cleared by previous ARIAs. In consideration of this, AMNS commissioned CRM Group to conduct an updated ARIA.	Potential interactions with cultural and heritage resources are assessed under the Cultural and Heritage Resources VC (Section 10.0). Also see Appendix C.1 for the 2021 ARIA report.
Land Use and Visual Impact	Project activities will not result in any new changes to third-party land use, not previously assessed for the Touquoy Gold Project. Public use of the Touquoy Mine Site is restricted and the nearest permanent residential dwelling is located approximately 5 km northwest of the Open Pit area. The Project will not result in any new atmospheric emissions (e.g., air, dust, noise, lights) that would affect residential or recreational land use in the area. Access to public roadways and logging trails will not be disturbed or restricted by Project activities. There may be however, changes to the previously assessed viewshed as a result of the proposed modifications. A Viewshed Analysis (GHD 2021, Appendix C.2) was conducted to evaluate potential visual impacts associated with the modification of the WRSA. The Viewshed Analysis identified that the WRSA may be visible from very few remote vantage	Further assessment as a VC is not required.

Table 5.1 Selection of Valued Components

Candidate Valued Component	Scoping Considerations	Recommendation for Assessment
	points. Given the location of the mine to most observer locations, it is noted that the WRSA will likely be indiscernible on the horizon. The design height of 170 MASL for the expanded WRSA is less than the 185 MASL assessed in the Viewshed Analysis. Project personnel will communicate any changes in land use or land disturbance with CLC members. The CLC will also bring to AMNS' attention any issues regarding complaints or concerns they are aware of within the communities that are related to the Touquoy Gold Project. AMNS commits to addressing community issues that are brought forward by the CLC on a timely basis.	
Population and Economy	The proposed Project modifications are not anticipated to adversely affect the local population and economy. However, in the absence of the proposed modifications the life of the Touquoy Gold Project could be shortened, thereby reducing potential economic benefits for the region including local employment and expenditures, and royalty payments.	Further assessment as a VC is not required.
Transportation	The Project is not anticipated to interact with the local transportation network other than through the construction of a new access point from Mooseland Road for the relocated Plant Access Road. Truck traffic to the Mine Site is not expected to increase as a result of the Project. The expansion of the Clay Borrow Area at the Mine Site may however reduce current traffic associated with use of offsite borrow areas. AMNS will obtain a Work within Highway Right-of-Way Permit from the Province prior to constructing the relocated Plant Access Road.	Further assessment as a VC is not required.

The following VCs have therefore been selected for the effects assessment:

- Groundwater Resources (Section 6.0)
- Surface Water Resources (Section 7.0)
- Fish and Fish Habitat (Section 8.0)
- Terrestrial Environment (Section 9.0)
- Cultural and Heritage Resources (Section 10.0)

5.2.3 Spatial and Temporal Boundaries

The scope of the assessment is defined by spatial boundaries (i.e., geographic extent of potential effects) and temporal boundaries (i.e., timing of potential effects). The spatial boundaries reflect the geographic range over which potential environmental effects may occur, whereas temporal boundaries identify when an environmental effect may occur throughout all phases of the Project.

Spatial boundaries for the assessment are described below, specific geographic information is provided in each VC section:

- The Project Development Area (PDA) represents the anticipated area of direct physical disturbance associated with construction, operation and decommissioning of the Project. It comprises the existing Open Pit, the WRSA Expansion Area, the new Clay Borrow Area, the RoW of the new Plant Access Road, and the area required for ancillary features associated with these Project components (e.g., ditching, monitoring wells, parking lot security guard house).
- The Local Assessment Area (LAA) encompasses the area within which Project-related environmental effects can be predicted or measured for assessment. A unique LAA is defined for each VC depending on potential interactions and presented in the VC assessment section.
- The Regional Assessment Area (RAA) is the area established for context in determination of significance of Project-specific effects. The RAA is VC-specific and is defined in each respective VC assessment section.

The temporal boundaries for the assessment of effects on surface water resources include the construction phase, operational phase, and closure phase, which includes the decommissioning and reclamation stage, and post-closure stage; the Project schedule is provided in Section 2.5.

5.3 RESIDUAL EFFECTS CHARACTERIZATION

Following the analysis of environmental effects pathways and mitigation measures, the residual environmental effects are characterized using the following criteria: direction, magnitude, geographic extent, timing, frequency, duration, reversibility, and ecological or socio-economic context. The descriptors used to characterize residual environmental effects for each VC are defined in Table 5.2.

Table 5.2 Characterization of Residual Environmental Effects

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect	**Positive**— an effect that moves measurable parameters in a direction beneficial to the VC relative to baseline **Adverse**— an effect that moves measurable parameters in a direction detrimental to the VC relative to baseline **Neutral**— no net change in measurable parameters for the VC relative to baseline
Magnitude	The amount of change in measurable parameters relative to existing conditions	**No Measurable Change**— no measurable adverse effect anticipated **Low**— effect occurs that is detectable, but is within normal variability of baseline conditions **Moderate**— effect occurs that would cause an increase (or decrease) with regard to baseline, but is within regulatory limits and objectives **High**— effect occurs that would cause exceedances of objectives or standards
Geographic Extent	The geographic area in which an environmental, effect occurs	**PDA**— residual effects are restricted to the Project Development Area **LAA**— residual effects extend into the LAA **RAA**— residual effects extend into the RAA
Duration	The period of time required until the measurable parameter returns to its existing condition, or the effect can no longer be measured or otherwise perceived	**Short-term**— residual effect restricted to construction or decommissioning, rehabilitation, and closure phases **Medium-term**— residual effect extends through the operation phase **Long-term**— residual effect extends beyond the operation phase **Permanent**— recovery to baseline conditions unlikely
Frequency	Identifies how often the residual effect occurs and how often during the project or in a specific phase	Single event— occurs once **Multiple irregular event**— occurs at no set schedule **Multiple regular event**— occurs at regular intervals **Continuous**— occurs continuously
Reversibility	Pertains to whether a measurable parameter can return to its existing condition after the project activity ceases	**Reversible**— the effect is likely to be reversed after activity completion and rehabilitation **Irreversible**— the effect is unlikely to be reversed

5.4 SIGNIFICANCE DETERMINATION

For each environmental effect, threshold criteria or standards are identified beyond which a residual environmental effect is considered significant. The thresholds are defined in consideration of federal and provincial regulatory requirements, standards, objectives, or guidelines, as applicable to the VC. Where thresholds are not set by guidelines or regulations, a threshold is developed using the measurable parameters established for the VC, along with professional judgement of the assessors. The thresholds define the limits of a change in a measurable parameter or state of the VC beyond which it would be considered significant, based on resource management objectives, community standards, scientific literature, or ecological processes (e.g., desired states for fish or wildlife habitats or populations).

6.0 GROUNDWATER RESOURCES

Groundwater resources include domestic, commercial, and industrial groundwater-source water supplies. Groundwater has potential to be a source of potable water; it is important in maintaining ecological habitats by supporting stream flow, vegetation, and wetlands; and is of cultural importance.

Groundwater is an integral component of the hydrologic cycle, is an important source of potable water for human consumption, and is a pathway to the following VCs:

- Surface Water VC (Section 7.0)– groundwater can interact directly with surface water resources and surface water ecosystems at points of discharge (e.g., lakes and streams).
- Fish and Fish Habitat (Section 8.0) – changes in groundwater quality and/or quantity can affect fish and fish habitat through associated changes in surface water quality and/or quantity.
- Terrestrial Environment VC (Section 9.0) – changes in groundwater levels can affect vegetation communities (wetlands) that are formed by or supported by groundwater.

6.1 POTENTIAL EFFECTS, PATHWAYS AND MEASURABLE PARAMETERS

Table 6.1 lists the potential Project effects on groundwater resources and provides a summary of the Project effect pathways and measurable parameters to assess potential effects. Potential environmental effects and measurable parameters were selected based on review of recent EAs for similar projects in Nova Scotia and other parts of Canada, and professional judgment.

Table 6.1 Potential Effects, Effects Pathways and Measurable Parameters for Groundwater Resources

Potential Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Groundwater Quantity	• Project activities will result in changes in groundwater recharge and changes to groundwater levels and flow. A decrease in groundwater levels may result in loss of yield to dug or drilled wells, reducing their ability to meet water supply requirements. • As a pathway to surface water and wetlands, a decrease in groundwater levels and changes in the natural groundwater flow could affect discharge to nearby surface water bodies (assessed in Section 6.0) and water levels within wetlands (assessed in Section 9.0).	• Reduction in baseflow (%) in surface water features supporting ecological habitat • Well yield (L/min) for existing well users in the Project Area

Table 6.1 Potential Effects, Effects Pathways and Measurable Parameters for Groundwater Resources

Potential Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Groundwater Quality	• Changes in groundwater levels and flow direction and recharge or infiltration from the Project activities may alter groundwater quality in dug or drilled wells, reducing their ability to meet water supply requirements without treatment. • As a pathway to surface water and wetlands, recharge or infiltration from Project activities may result in changes to groundwater quality discharging to surface water (assessed in Section 7.0).	• Concentration of chemical parameters (various) in groundwater compared to applicable guidelines (e.g., arsenic, cobalt, sulfate, nitrate, selenium, iron, sodium, chloride)

6.2 BOUNDARIES

The scope of the assessment is defined by spatial boundaries (i.e., geographic extent of potential effects) and temporal boundaries (i.e., timing of potential effects). Spatial boundaries for groundwater resources were selected in consideration of the geographic extent over which Project activities, and their effects, are likely to occur on the VC. Temporal boundaries are based on the timing and duration of Project activities and the nature of the interactions with the VC. The spatial and temporal boundaries associated with the effects assessment for groundwater resources are described in the following sections.

6.2.1 Spatial Boundaries

The following spatial boundaries were used to assess Project effects, including residual environmental effects, on groundwater resources in areas surrounding the WRSA expansion, new Clay Borrow Area, Plant Access Road and in-pit tails deposition.

Project Development Area: The PDA encompasses the Project footprint and is the anticipated area of physical disturbance associated with the construction, operation and decommissioning of the project. It includes the 7.1 ha footprint of the WRSA Expansion, the 5.9 ha footprint of the new Clay Borrow Area, the RoW for the new Plant Access Road, the existing Open Pit, and the area required for ancillary features (Figure 2.1).

Local Assessment Area: The LAA is the area in which both: a) project-related effects (direct or indirect) can be predicted or measured with a level of confidence that allows for assessment; and b) there is a reasonable expectation that those potential effects in the LAA will be an issue of public interest. The LAA encompasses the PDA and is VC specific. The LAA for the Groundwater Resources VC includes the Moose River watershed and portions of the Fish River watershed (Figure 6.1).

Regional Assessment Area: The RAA is the area that establishes the context for determining significance of project-specific effects. It is also the area within which potential cumulative effects—the residual effects from the Project in combination with those of past, present, and reasonably foreseeable projects—are assessed. For groundwater resources, the RAA is the same as the LAA, as the LAA incorporates all Project-related effects.

6.2.2 Temporal Boundaries

The temporal boundaries for the assessment of effects on groundwater resources include the construction phase, operation phase, and closure phase, which includes the decommissioning and reclamation stage, and post-closure stage; the project schedule is provided in Section 2.5.

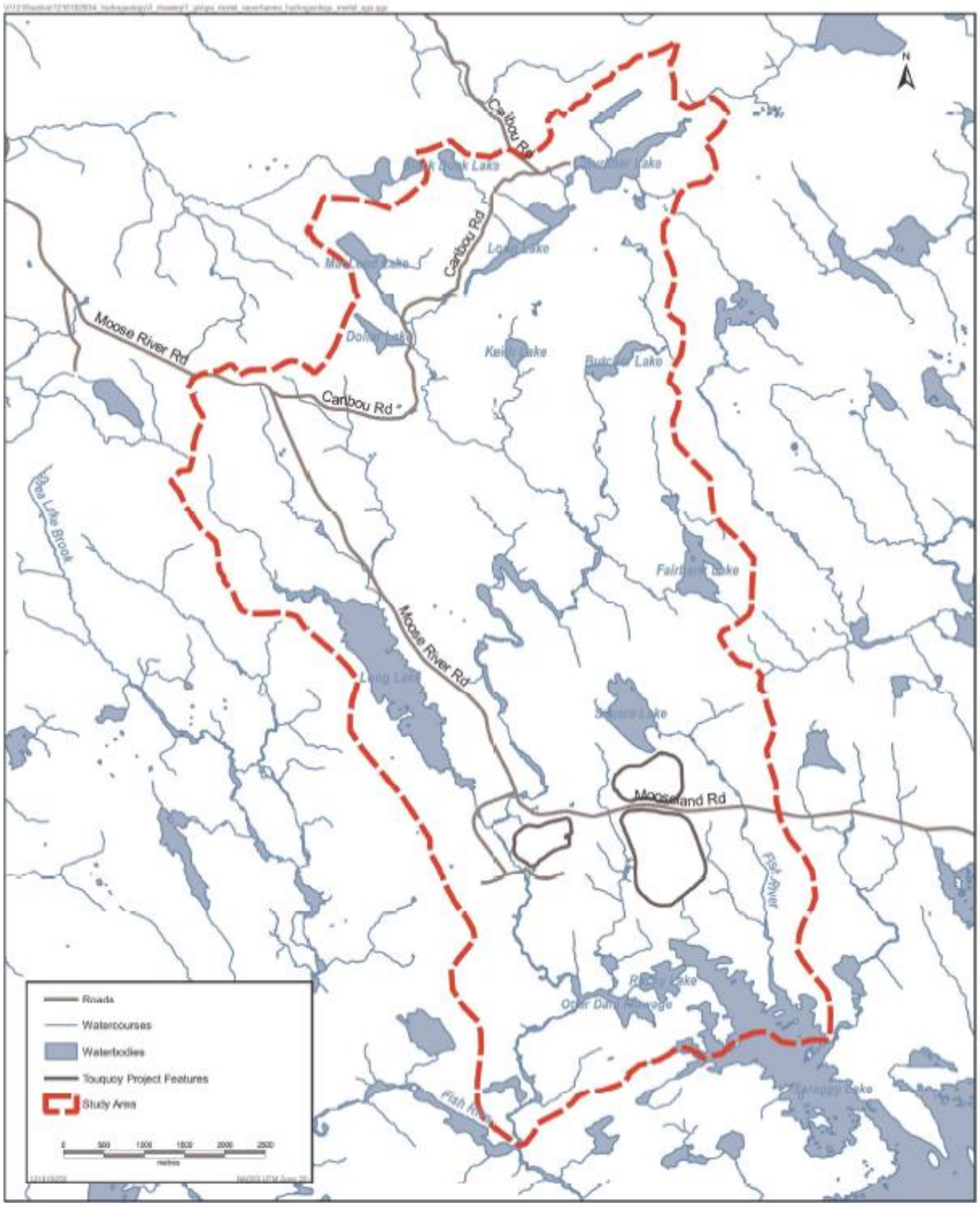


Figure 6.1 Local and Regional Assessment Area of Groundwater Resources

6.3 SIGNIFICANCE DEFINITION

For the purposes of this EARD, a significant adverse residual effect on groundwater resources is defined as a measurable Project-related environmental effect that results in one or more of the following:

- Decrease in the yield from an existing and otherwise adequate groundwater supply well such that, following the application of mitigation, it is inadequate for its intended use
- Change in groundwater quality, such that the quality of groundwater from an otherwise adequate water supply well that meets applicable guidelines deteriorates to the point where it becomes non-potable or cannot meet the Guidelines for Canadian Drinking Water Quality (GCDWQ; Health Canada 2020) for a consecutive period exceeding 30 days

6.4 BASELINE CONDITIONS

6.4.1 Pre-Development Conditions

The following description of pre-development conditions at the Touquoy Mine Site (i.e., before the site was developed for the mine) has been adapted from the on-site investigations of pre-development surface and groundwater quality, as reported in the annual groundwater and surface water monitoring reports prepared as part of the IA for the site (Stantec 2017, 2018a), and for data from the EARD for the Touquoy Gold Project (CRA 2007a) and the Focus Report for the Touquoy Gold Project (CRA 2007b).

The LAA is located in a region of the province having relatively low relief with hummocky type terrain, characterized by rolling till plains, drumlin fields, extensive rock land, and numerous freshwater lakes, streams, bogs, and wetlands. The complex system of surface drainage is a direct result of the underlying bedrock geology of greywacke and argillite found in the region. These relatively impermeable and poorly jointed rocks result in slow groundwater recharge and most of the excess surface water runs off or is retained on the surface, in what is often called a 'deranged' drainage pattern.

Site hydrogeology consists of a fractured rock aquifer system overlain by a thin aquifer in the till. The degree of hydraulic connection amongst the smaller bedrock fracture systems is poor to moderate, and the main zones that are capable of storing and transmitting groundwater are the larger scale faults. The water table is close to the surface across the Touquoy 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 were saturated with groundwater under ambient pre-development conditions.

6.4.1.1 Groundwater Quantity and Flow

Pre-development hydrogeological conditions for the Touquoy Gold Deposit site are described by Peter Clifton & Associates (PCA) (2006) in Appendix H of the EARD (CRA 2007a) primarily in the vicinity of the Open Pit. They determined that the volume of groundwater stored in the bedrock aquifer was small due to the relatively small primary porosity of these rocks. However, they indicated that some of the larger bedrock structures may be hydraulically connected to surface water bodies that could become sources of aquifer recharge under a mine dewatering scenario.

Eight vertical boreholes specifically targeting potential structural aquifers to depths beneath the Open Pit to evaluate groundwater flow in bedrock. Water flows in the bedrock were low, ranging from 0 to 0.5 litres per second (L/s), with higher yields (up to 5 L/s) in the overburden.

Groundwater flow in the area is predominately within 2 to 3 m of ground surface. Test pitting and drilling in the TMF area characterized the top 3 m and next 7 m of bedrock as having transmissivities of 1×10^{-4} metres per second (m/s) and 1×10^{-6} m/s, respectively. Transmissivity below the weathered layer of bedrock is estimated at 1×10^{-8} m/s. Thus, the natural ground at depth is relatively impermeable.

Given the shallow water table in the LAA and combined with a water surplus and general low permeability of the area, the pre-development groundwater flow system is characterized as a local system, with topographic highs representing recharge zones that would discharge into the adjacent topographic lows (CRA 2007b). Till overburden within the LAA was expected to create non-flowing artesian conditions within the bedrock. Groundwater-stream interaction was expected to be controlled by the thickness, continuity, and permeability of the confining till overburden (CRA 2007b).

Jacques Whitford (2008) prepared a Groundwater Monitoring Plan as part of the IA application for the Touquoy Mine Site. The series of 32 multi-level well pairs proposed in the plan were installed by GHD Limited at the Touquoy Mine Site (GHD Limited 2016a,b). The monitoring wells were installed around the Touquoy Mine Site component areas, as shown on Figure 6.2. The naming convention for the wells identifies the Project component that is monitored by the well: the process plant (PLM-series wells), the open pit mine (OPM-series wells), the WRSA (WRW-series wells), and the TMF (TMW-series wells). The nested groundwater monitoring well pairs consist of one shallow well installed to intercept the water table (naming convention with suffix A) in the till/upper weathered and shallow fractured bedrock, and the other deep well installed in less fractured and more competent bedrock (naming convention with suffix B). Groundwater monitoring has been ongoing at the Touquoy Mine Site at these wells since 2016 to characterize the groundwater conditions in the overburden and bedrock (water levels and chemistry).

Single-well response tests were conducted on wells across the Touquoy Mine Site, including all of the monitoring wells installed as part of the groundwater monitoring program (GHD Limited 2016a,b). The hydraulic conductivity estimates were fairly consistent across the site, in both the silty-sand till overburden (geometric mean of 1.8×10-6 m/s), and in the relatively shallow bedrock (geometric mean of 1.0×10-6 m/s). No differentiation of hydraulic conductivity in the bedrock was observed in wells constructed in the two dominant argillite and greywacke bedrock lithologies.

Groundwater – surface water interactions were assessed by calculating baseflow in Moose River. Total stream flow was estimated for Moose River at SW-2 through analysis and review of stream flow data collected at nearby hydrometric stations. Pre-development mean annual flow in Moose River is estimated to be 1.15 m^3/s. Baseflow indices were calculated using a recursive baseflow filter implemented in the BFLOW software code (Arnold et al. 1995) for annual and monthly streamflow rates observed in Moose River at SW-2. The mean annual baseflow index for Moose River is estimated to be 0.29. The calculated mean annual baseflow in Moose River at SW-2 is 28,814 m^3/d.

Stantec constructed a three-dimensional steady-state groundwater flow model and solute transport model, using MODFLOW (Appendix D.1). This model simulates pre-development groundwater conditions, baseline conditions when the tailings disposal operation begins at the Touquoy Mine Site, changes to groundwater inflows during operation (i.e., while tailings are deposited in the Open Pit), and to evaluate potential changes to water quality in the receiving environment due to the subaqueous disposal of tailings in the Open Pit post-closure (i.e., when the Open Pit is full) (Stantec 2021b; Appendix D.1). The model was prepared using a conceptual model and hydro-stratigraphic framework developed from regional and site-specific data and assumed homogeneous properties within the units. A good calibration of model parameters was obtained, as evaluated by comparing simulated and observed groundwater levels and estimated baseflow. The parameter values for hydraulic conductivity are similar to those obtained from other analyses of field observations (Stantec 2021b; Appendix D.1).

The flow model was adjusted to reflect the pre-development conditions at the Touquoy Mine Site by calibrating the model to remove the drain cells boundary condition representing the existing Open Pit conditions. This results in active cells without a specified boundary condition. Figure 6.3 shows the water table elevation under pre-development conditions, based on the calibrated groundwater flow model. The model provides a good representation of the expected pre-development groundwater flow conditions with groundwater in the area of the Open Pit flowing from the water table high near east of the existing Open Pit toward Moose River. The model was used to estimate the groundwater discharge to Moose River and its tributaries upstream of surface water monitoring location SW-2. The net pre-development baseflow to Moose River at SW-2 is simulated to be 29,845 m^3/d under average annual conditions, and 9,689 m^3/d under summer conditions (Stantec 2021b; Appendix D.1).

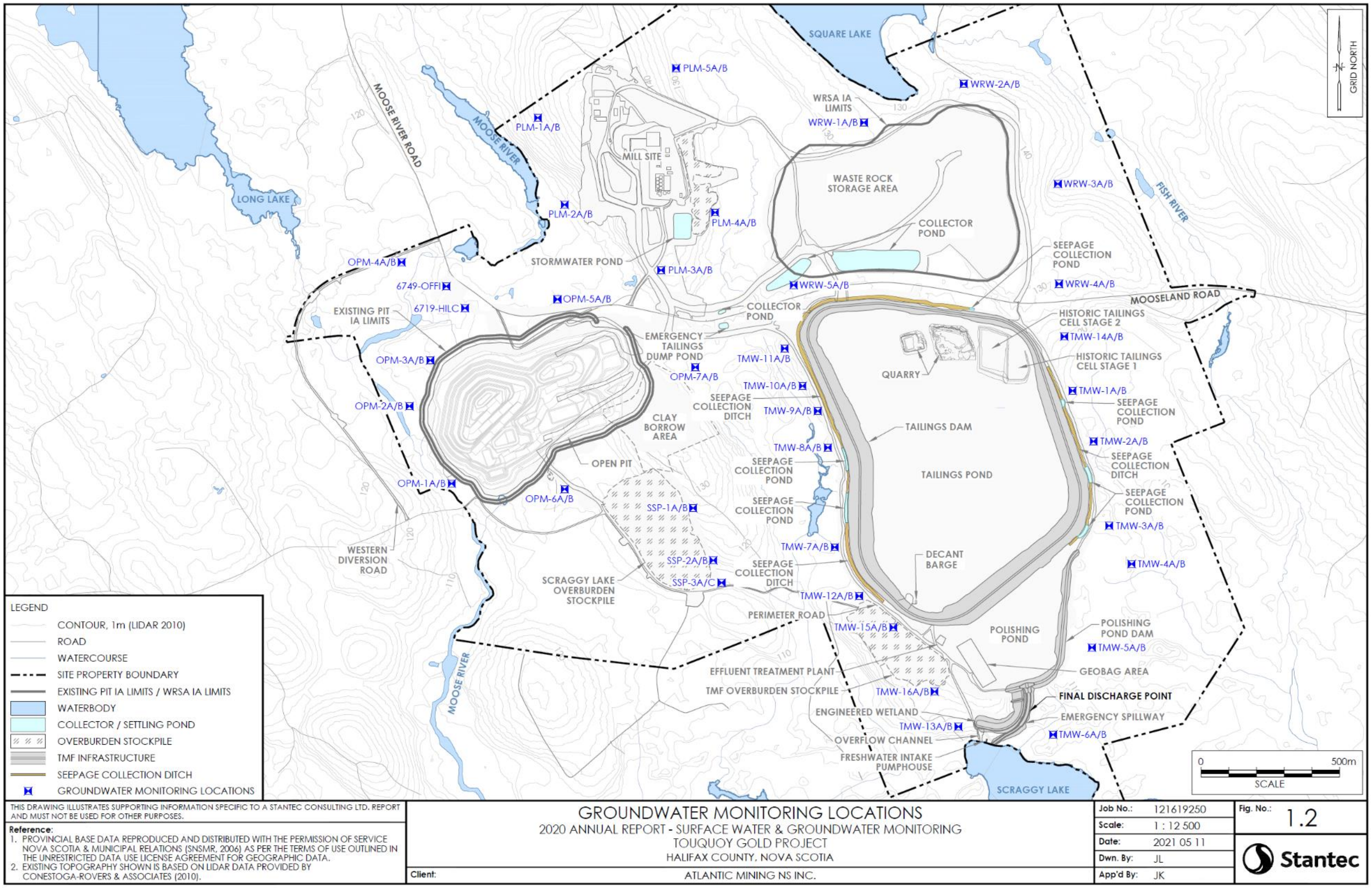


Figure 6.2 Groundwater Monitoring Locations for the Touquoy Mine Site

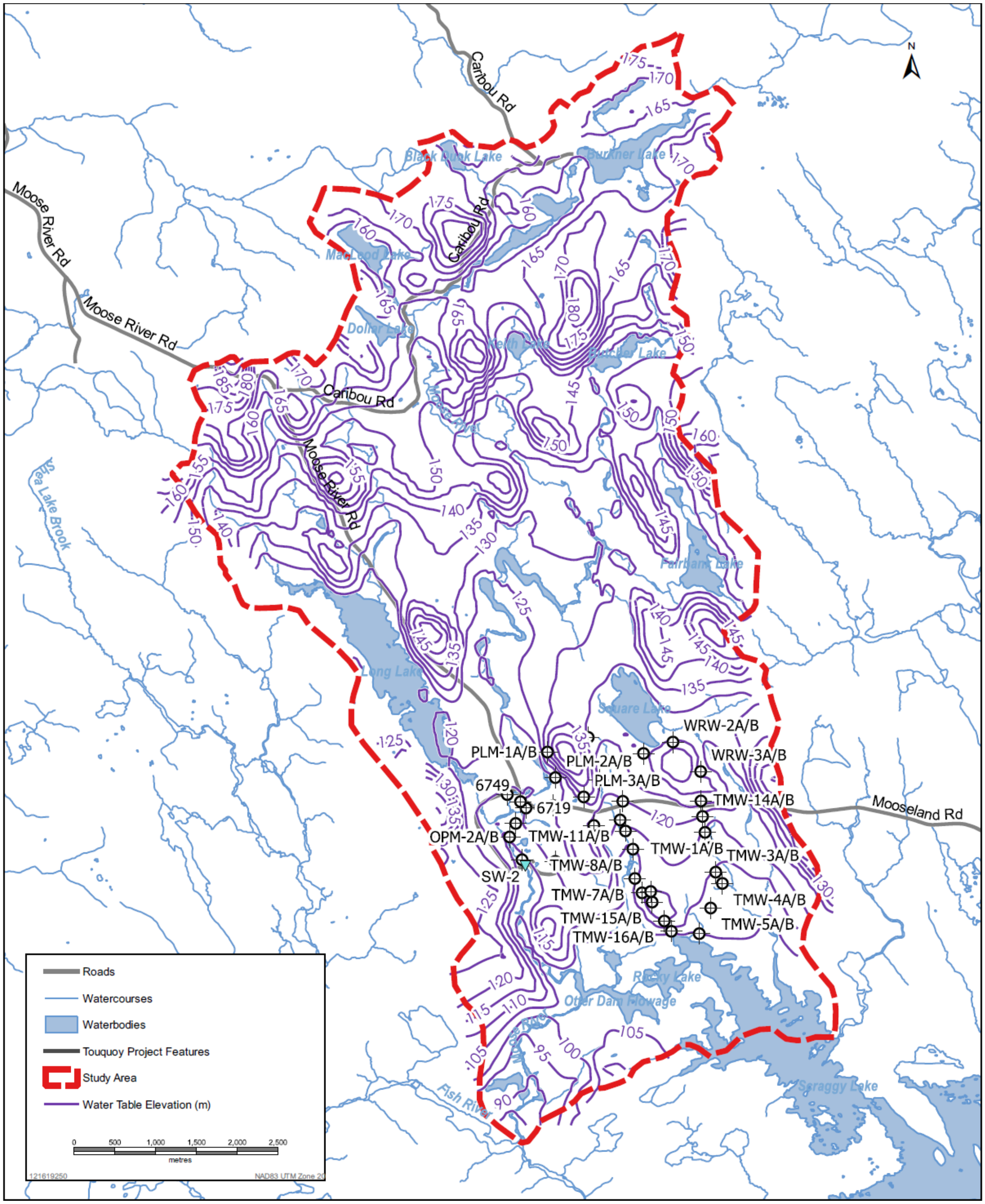


Figure 6.3 Water Table Elevation Contours under Average Annual Pre-Development Conditions

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6.4.1.2 Groundwater Quality

Pre-development groundwater quality is described primarily through groundwater samples collected as part of the baseline period (2016 to 2017) IA, as presented in Stantec (2018a). The groundwater quality presented in the groundwater VC are compared to the GCDWQ Maximum Acceptable Concentrations (MAC). However, because NSECC has also specified water quality objectives for groundwater at in the PDA as part of the IA (i.e., the Column A and Column B criteria presented in Appendix K, Table 6 of the IA), the groundwater quality is also compared to these criteria. The Column B criteria in the IA are generally derived from the GCDWQ MAC, with a few exceptions. The GCDWQ MAC, and IA criteria are presented on Table 6.2.

Table 6.2 Site Water Monitoring Criteria Specified in Industrial Approval

Parameter	Units	GCDWQ MAC	Industrial Approval Column A	Industrial Approval Column B
Chloride	mg/L	250	120	250
Fluoride	mg/L	1.5	0.12	1.5
Nitrate (as N)	mg/L	10	10	10
Nitrite (as N)	mg/L	1	1	1
Unionized Ammonia (as N)	mg/L	-	0.019	-
Aluminum	µg/L	-	5 (if pH is <6.5); 100 (if pH is ≥6.5)	-
Antimony	µg/L	6	6	6
Arsenic	µg/L	10	5	10
Barium	µg/L	1000	1000	1000
Beryllium	µg/L	-	4	4
Boron	µg/L	5000	1200	5000
Cadmium	µg/L	5	0.04 (if Hardness is <17 mg/L); $10^{\{0.83(\log[hardness])-2.46\}}$ (if Hardness is ≥17 mg/L to ≤280 mg/L); 0.37 (if Hardness is >280 mg/L)	5
Chromium (Total)	µg/L	50	-	50
Chromium (VI)	µg/L	-	1	-
Cobalt	µg/L	-	10	10
Copper	µg/L	2000	2 (if Hardness is <82 mg/L); $0.2*e^{\{0.8545(\ln[hardness])-1.465\}}$ (if Hardness is ≥82 mg/L to ≤180 mg/L); 4 (if Hardness is >180 mg/L)	2000
Cyanide (Free)	µg/L	200	5	200
Iron	µg/L	-	300	-
Lead	µg/L	5	1 (if Hardness is ≤60 mg/L); $e^{\{1.783(\ln[hardness])-4.705\}}$ (if Hardness is >60 mg/L to ≤180 mg/L); 7 (if Hardness is >180 mg/L)	5

Table 6.2 Site Water Monitoring Criteria Specified in Industrial Approval

Parameter	Units	GCDWQ MAC	Industrial Approval Column A	Industrial Approval Column B
Manganese	µg/L	120	120	120
Mercury (Total)	µg/L	1	0.026	1
Molybdenum	µg/L	-	73	-
Nickel	µg/L	-	25 (if Hardness is ≤60 mg/L); $e^{\{0.76(\ln[hardness])+1.06\}}$ (if Hardness is >60 mg/L to ≤180 mg/L); 150 (if Hardness is >180 mg/L)	-
Selenium	µg/L	50	1	50
Silver	µg/L	-	0.1	100
Sodium	µg/L	-	200000	200000
Strontium	µg/L	7000	7000	7000
Thallium	µg/L	-	0.8	2
Tin	µg/L	-	4400	4400
Uranium	µg/L	20	15	20
Vanadium	µg/L	-	6	6.2
Zinc	µg/L	-	$e^{\{0.947(\ln[hardness])-0.815(pH)+0.398(\ln[DOC]+4.625\}}$ (if Hardness is 23.4 to 399 mg/L, pH is 6.5 to 8.13, and DOC is 0.3 to 22.9 mg/L)	5000
Benzene	mg/L	0.005	0.005	0.005
Toluene	mg/L	0.06	0.002	0.06
Ethylbenzene	mg/L	0.14	0.09	0.14
Total Xylenes	mg/L	0.09	0.09	0.09
Modified TPH – Gasoline	mg/L	-	1.5	4.4
Modified TPH – Fuel Oil	mg/L	-	0.1	3.2
Modified TPH – Lube Oil	mg/L	-	0.1	7.8

GCDWQ MAC = Guidelines for Canadian Drinking Water Quality Maximum Acceptable Concentration

The pre-development groundwater quality across the site is summarized graphically for the OPM and WRW series wells on Figure 6.4 and Figure 6.5, including a comparison of the GCDWQ and the IA Column A and Column B water quality criteria. However, as all wells are located more than 10 m from a watercourse or waterbody, the following discussion only focusses on comparisons of the GCDWQ and IA Column B criteria (Table 6.2)

The pre-development groundwater quality in the vicinity of the Open Pit is summarized on Figure 6.4. The mean concentrations of arsenic and manganese exceed the GCDWQ and IA Column B criteria, and the maximum concentrations exceed the criteria for lead and mercury. The groundwater in the vicinity of the WRSA is summarized on Figure 6.5. The mean concentrations of manganese, and the maximum concentrations of arsenic exceed the GCDWQ and IA Column B criteria.

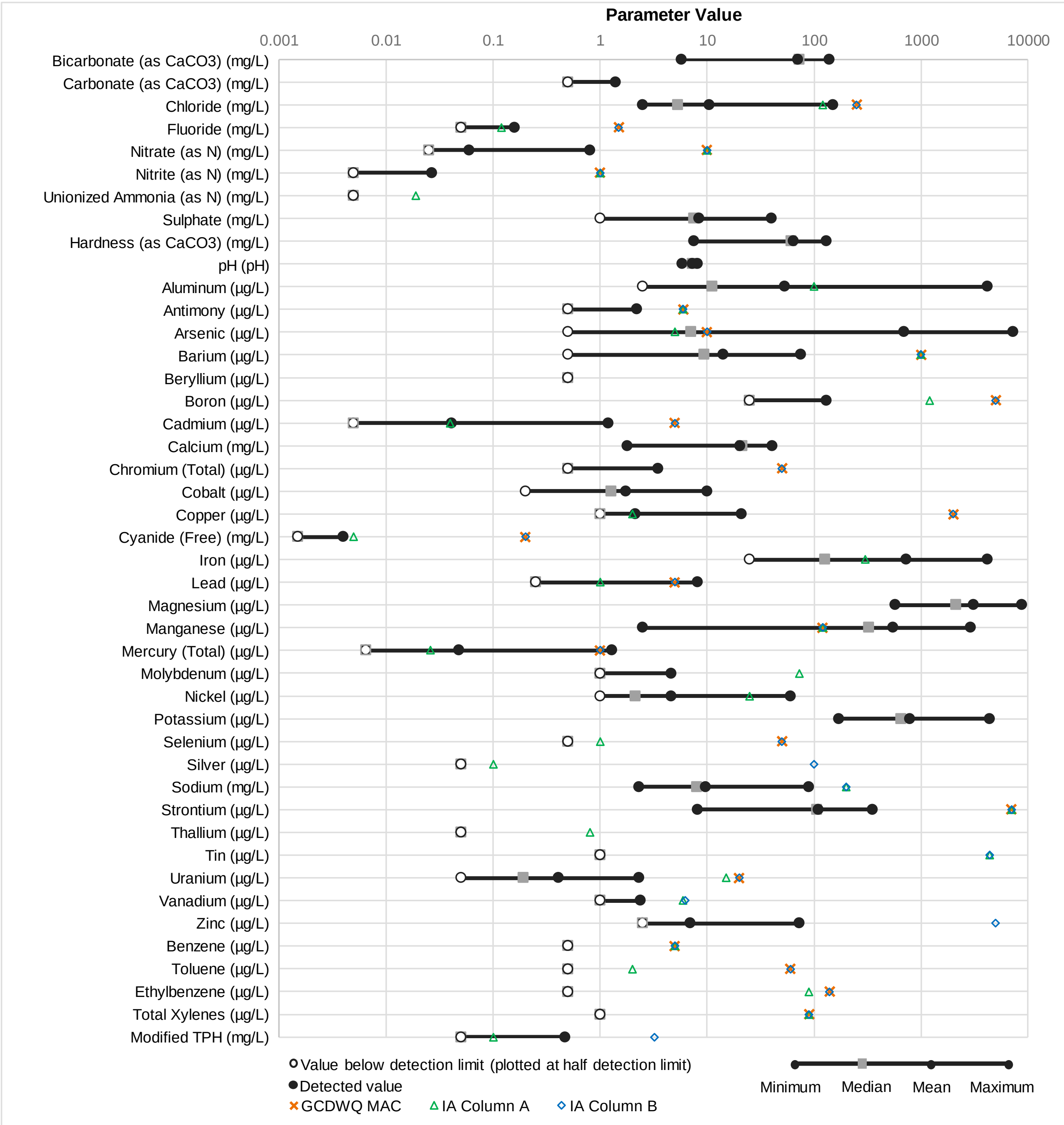

Figure 6.4 Summary of Pre-Development Water Quality in OPM-Series Wells

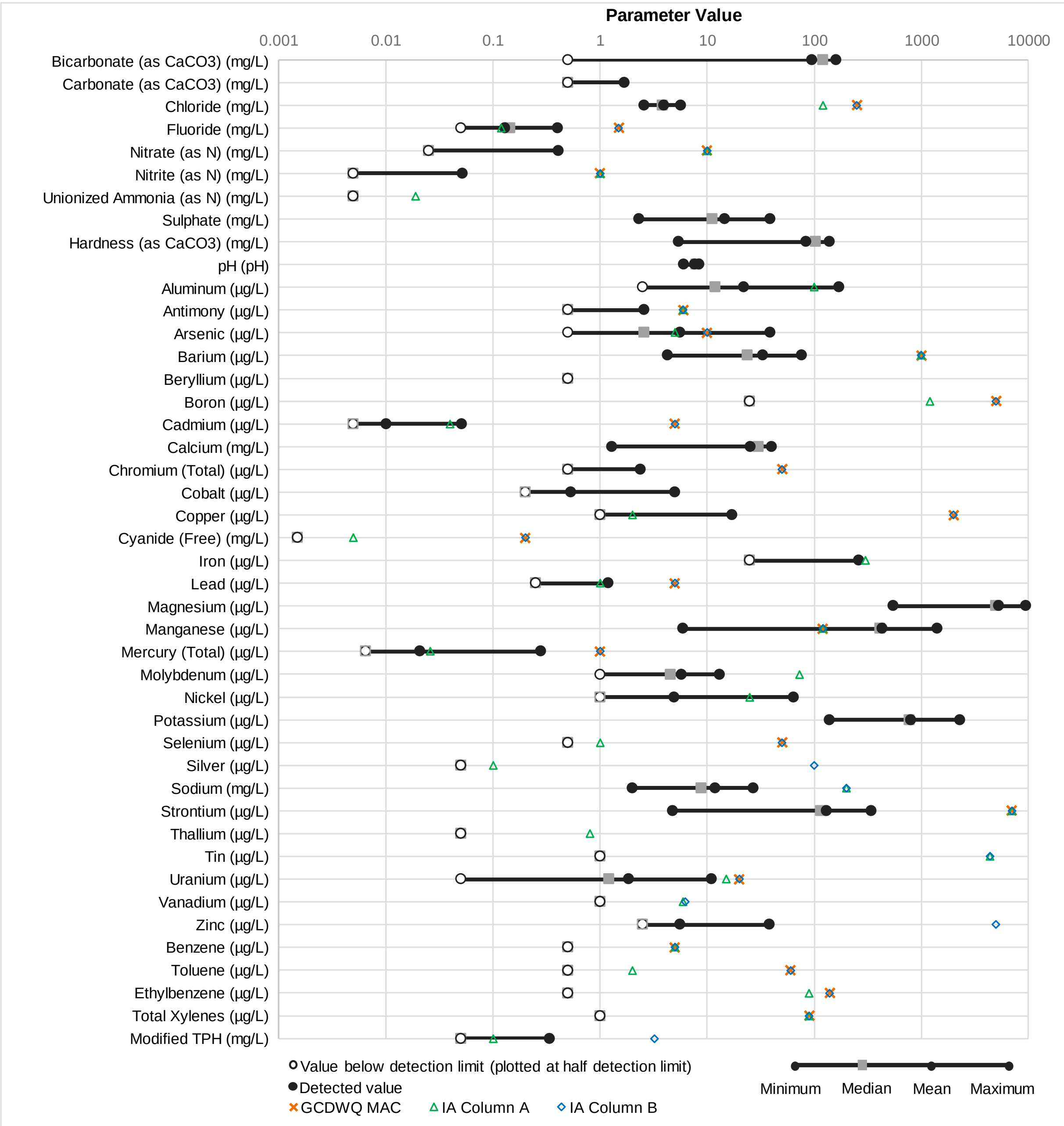

Figure 6.5 Summary of Pre-Development Water Quality in WRW-Series Wells

6.4.2 Existing Conditions

The following describes existing conditions at the Touquoy Mine Site (i.e., current operating conditions, without the proposed modifications). The information presented in this section is based on the 2020 annual groundwater and surface water monitoring report prepared as part of the IA for the site (Stantec 2021f; SD 19a).

Only one potential groundwater well user is known to occur within 5 km of the PDA: 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 plant and TMF are located approximately 7.4 km to the northwest and 11.7 km to the southeast.

6.4.2.1 Groundwater Quantity and Flow

As indicated in Section 6.4.1.1 above, groundwater monitoring has been ongoing at the Touquoy Mine Site since 2016 to characterize the groundwater conditions in the overburden and bedrock (water levels and chemistry). There are 36 groundwater monitoring stations (i.e., nested well pairs) at the Touquoy Mine Site (Figure 6.2) that were actively monitored in 2020 (Stantec 2021f; SD 19a). These include the monitoring wells installed around the areas shown in Figure 6.2, with additional groundwater wells installed by Stantec in June 2018 (nested well pair TMW-9A/B) and in June/August 2020 (nested well pairs SSP-1A/B, SSP-2A/B and SSP-3A/C.

The existing operating conditions at the Touquoy Mine Site during operation are represented by the water quality from November 2017 to December 2020. Monitoring methods and results are described in detail in the 2020 Annual Groundwater Monitoring Report for the Touquoy Gold Project (Stantec 2021f; SD 19a).

Groundwater levels were monitored monthly at each well. The levels were referenced to an elevation relative to the Canadian Geodetic Vertical Datum of 2013 (CGVD 2013). Contours were derived from the groundwater elevations and topographical surface contours and are presented in Figure 6.6 for water table conditions in August 2020. The groundwater elevation trends are presented on Figure 6.7 and Figure 6.8for the monitoring wells associated with the Open Pit and WRSA Project component areas (i.e., OPM-series wells and WRW-series wells), respectively.

Figure 6.7 and Figure 6.8 show that water elevation is typically lower in the deeper wells (B) than in the shallower wells (A) and well pairs generally have a similar hydraulic response. Weak vertical gradients are noted in some well pairs and may change direction depending on rainfall, such as WRW-5A/B, OPM-3A/B, OPM-5A/B, OPM-6A/B, and OPM-7A/B. Groundwater monitoring wells WRW-3A/B and OPM-4A/B have an upward gradient. Consistent changes in vertical gradients between well pairs from 2016 baseline to 2020 operation were noted.

Groundwater elevations are highest in WRW-2A and are lowest in TMW-6A/B, which is consistent with the surface topography. OPM-2B also has a low groundwater elevation, likely due to Open Pit dewatering (Stantec 2021f; SD 19a). Seasonality in water elevation can be noted as water elevation drops during periods of low flow in the summer and rises in high flow periods in the spring. Some wells respond to seasonal changes in precipitation more than others. Reasons for this may be a result of the geology of the groundwater aquifer or well construction. Some groundwater monitoring wells (e.g., OPM-5A/B and WRW-3A) show a near constant groundwater elevation with little response to precipitation events; these wells are likely controlled by natural hydraulic features. For example, OPM-5A/B is likely controlled by the level in the local road drainage facilities and WRW-3A/B by the water level in the existing unnamed tributary to the east.

Groundwater monitoring wells OPM-1A/B, OPM-2A/B and OPM-3A/B are located between the Open Pit and Moose River. Groundwater declines in these wells are monitored against action levels assigned in the GWCP (GWCP; Stantec 2019a). If the water level drop between consecutive monthly readings is greater than the 2016 baseline annual range of water levels, the GWCP is triggered for the operation of the Open Pit.

A declining trend has been observed at OPM-2B, and to a lesser degree at OPM-2A, throughout 2017, 2019, and 2020 operation; this trend is attributed to dewatering of the Open Pit (Stantec 2020c, 2021f). The GWCP was triggered in 2019 (and 2020) based on the depressed water table at OPM-2A/B. A review of the water levels and streamflow rates in Moose River indicated that the depressed water table appears to have a minor influence on stream flows in Moose River during the low-flow period. This minor influence is attributed to the interception of groundwater in the Open Pit that would have otherwise discharged to Moose River. Additional investigations were conducted in 2020, including the characterization of fish habitat in Moose River, continued monitoring of stream flows, and updating the groundwater flow modelling to quantify the volume of groundwater intercepted during mean annual and mean summer conditions. The reductions in flow rates in Moose River are greater than the dewatering rates from the Open Pit, and therefore cannot be solely attributed to baseflow reductions to Moose River associated with the Open Pit. Uncertainty in flow measurements at the upstream station SW-11 due to aquatic vegetation, and heavy evapotranspiration losses in the summer months may account for a portion of the additional flow reductions observed at SW-2. Project-related effects to surface water flows are predicted to be less than 5%, therefore no adverse effects to the aquatic environment were identified.

Unlike surface water, fluctuations in water level are more gradual in groundwater as precipitation and runoff typically takes longer to recharge the aquifer than to reach the stream.

Stantec (2021b; Appendix D.1) conducted groundwater flow modelling to evaluate disposal of tailings in the Open Pit, including modelling baseline conditions when tailings disposal operation begins at the Touquoy Mine Site (i.e., when the Open Pit has been fully excavated and completely dewatered). To simulate these conditions, the model drain cells representing the seepage face boundary condition in the model were adapted to reflect the fully developed Open Pit, which is approximately 95 m deeper than the Open Pit that was simulated during initial model calibration in August 2019. This was run for the average annual conditions to estimate the long-term water table position, and to quantify the baseflow to Moose River and pit inflow rates. The average summer conditions were also run to quantify the baseflow to Moose River and pit inflow rates.

The predicted average annual steady-state groundwater drawdown contours for the average annual baseline conditions are presented on Figure 6.6. The extent of the drawdown cone, as delineated by the 0.5 m drawdown contour, extends approximately 350 m south of the Open Pit and about 50 m west of the Open Pit toward Moose River. The pit inflow rates and net baseflow to Moose River at SW-2 are presented on Table 6.3. Compared to the conditions in August 2019, the groundwater inflows to the Open Pit are anticipated to increase by 68 m^3/d (9.5%) on a mean annual basis, and 42 m^3/d (10.4%) on a summer flow basis. The dewatering of the fully developed Open Pit is anticipated to reduce the baseflow in Moose River at SW-2 by 49 m^3/d on a mean annual basis, and 29 $m^{3/}d$ on a summer flow basis.

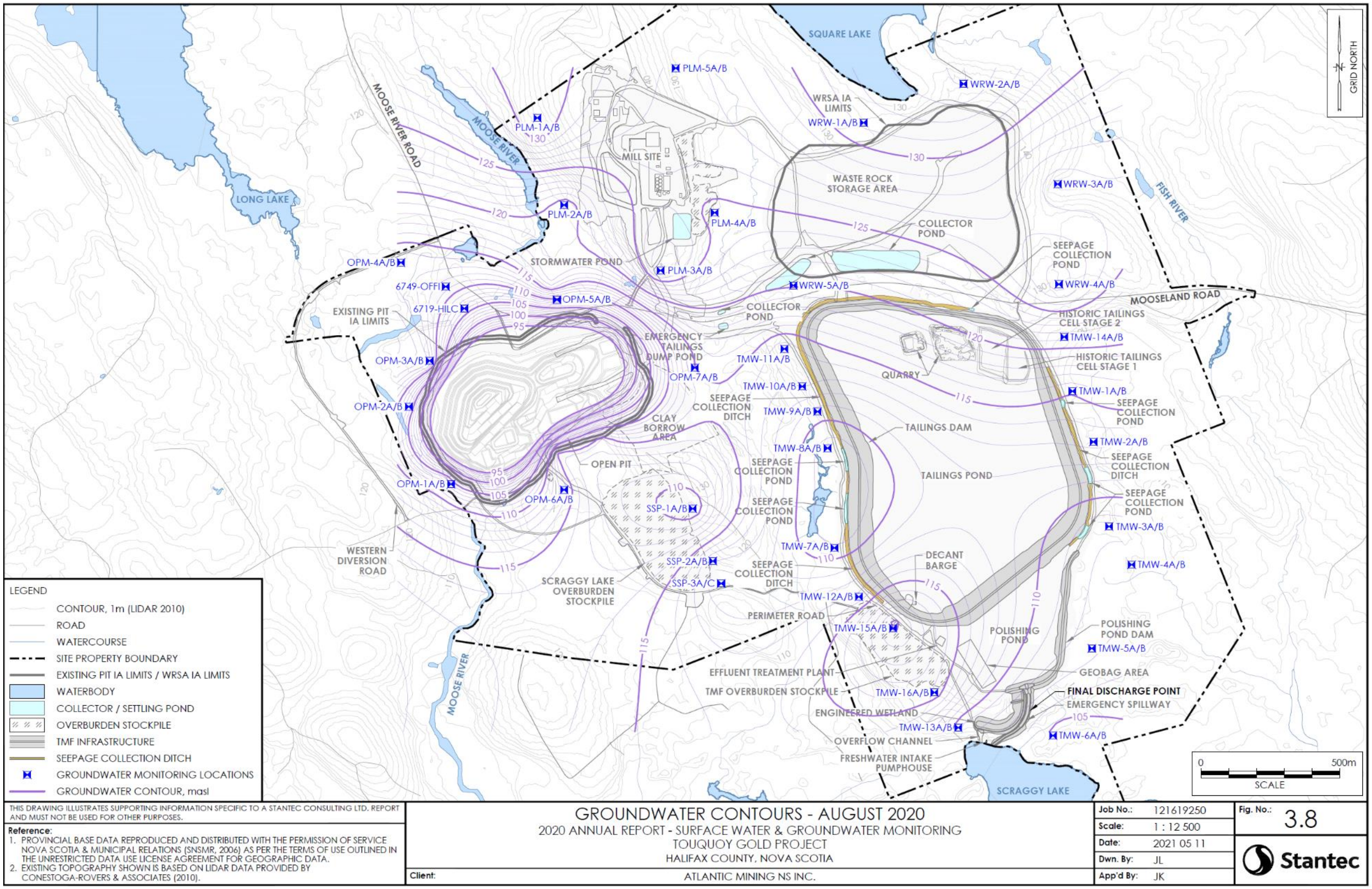

Figure 6.6 Groundwater Contours at the Touquoy Mine Site – August 2020

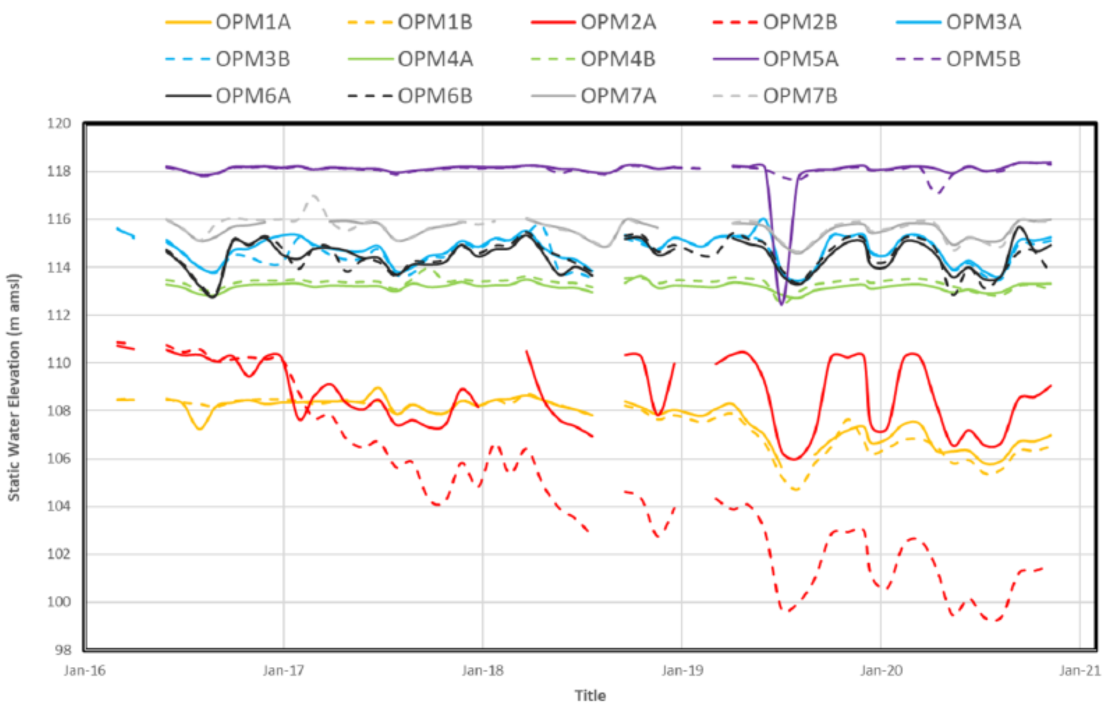

Figure 6.7 Groundwater Level Monitoring and Open Pit Mine (OPM) Wells

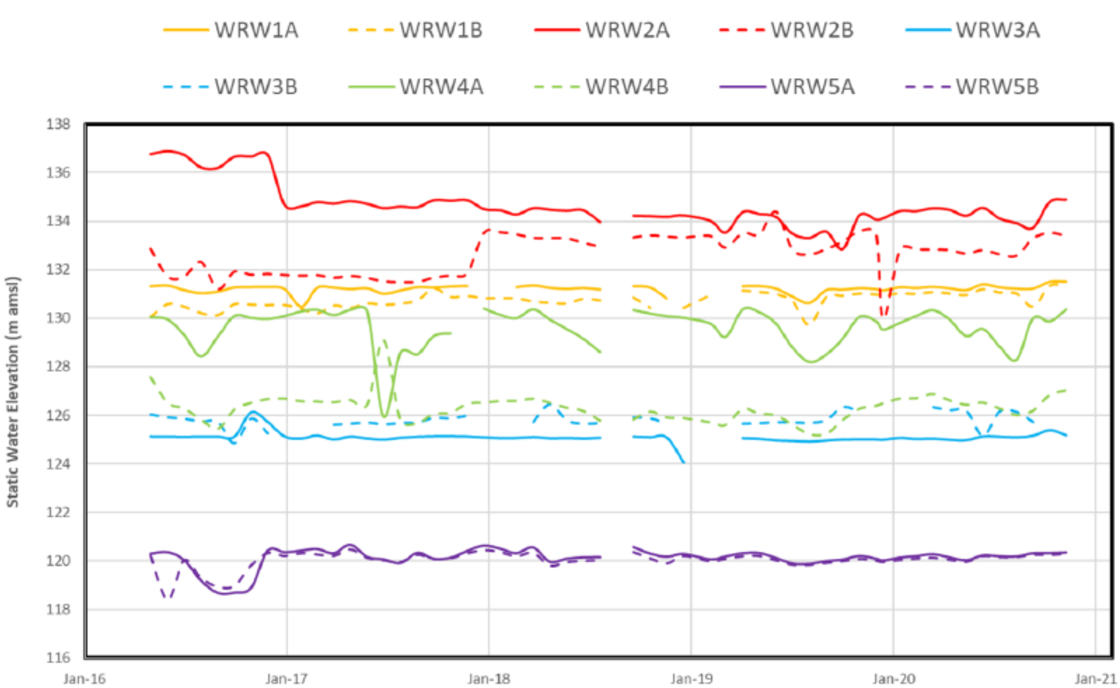

Figure 6.8 Groundwater Level Monitoring Results at Waste Rock (WRW) Wells

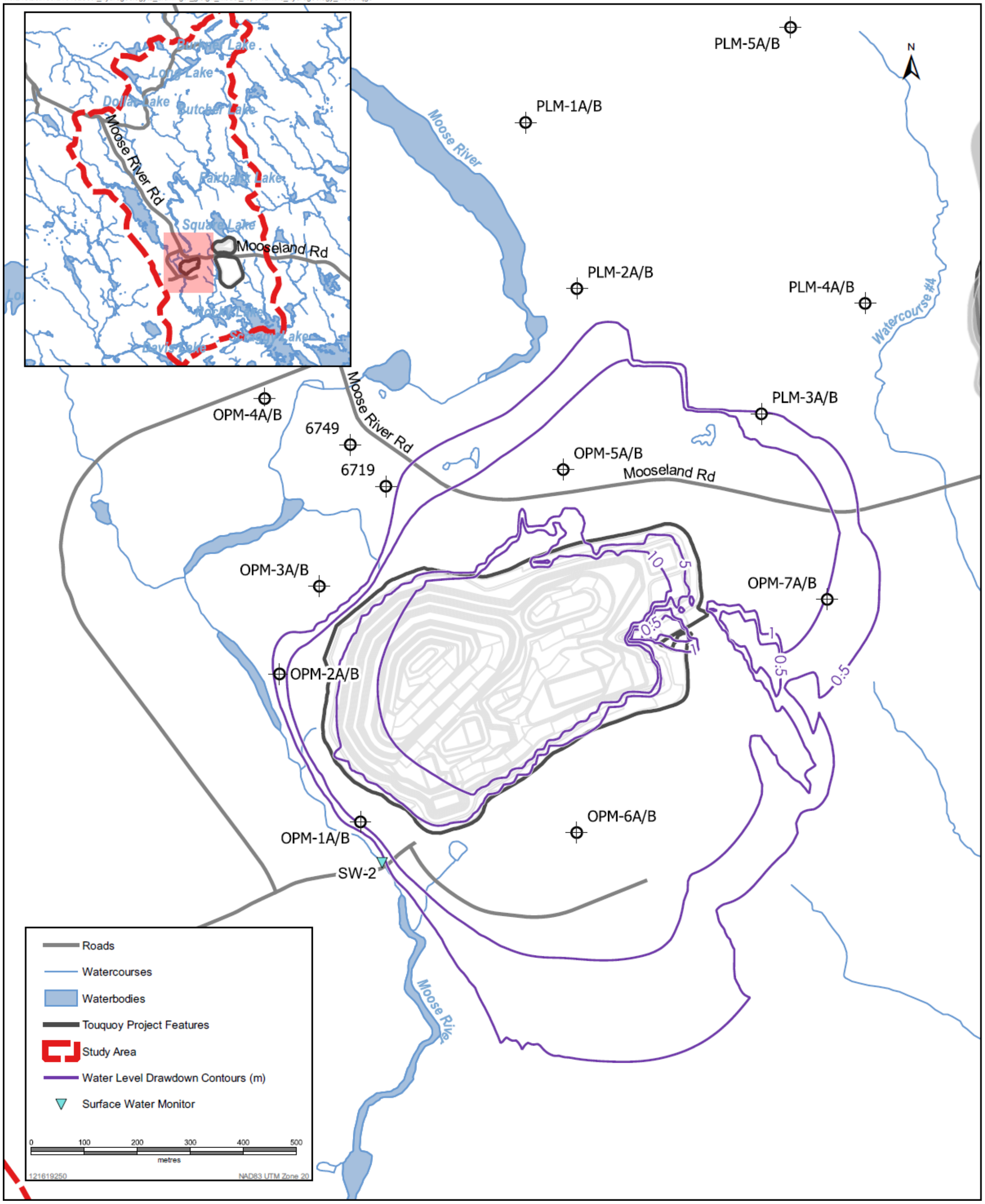

Figure 6.9 Drawdown at Average Annual Baseline Conditions (Fully Dewatered Pit)

Table 6.3 Comparison of August 2019 and Baseline Groundwater Flows (m^3/d)

Flow Target	August 2019 Conditions	Baseline (Full Depth Pit)
Moose River Annual Baseflow	29,346	29,297
Moose River Summer Baseflow	9,386	9,357
Annual Pit Inflow	700	768
Summer Pit Inflow	402	444

6.4.2.2 Groundwater Quality

As indicated in Sections 6.4.1.1 and 6.4.2.1 above, groundwater monitoring has been ongoing at the Touquoy Mine Site since 2016 to characterize the groundwater conditions in the overburden and bedrock (water levels and chemistry). As described in the 2020 Annual Groundwater Monitoring Report for the Touquoy Gold Project (Stantec 2021f; SD 19a), groundwater quality was monitored quarterly at 73 monitoring wells (including 36 nested groundwater monitoring well pairs) between January and December 2020. The locations of these groundwater monitoring wells are shown Figure 6.2 above. The statistics from the groundwater monitoring results from November 2017 to December 2020 were used to represent operating conditions at the Touquoy site for comparison to the baseline hydrogeologic conditions.

The existing groundwater quality across the site is summarized graphically for the OPM and WRW series wells on Figure 6.10 and Figure 6.11 including a comparison of the GCDWQ and the Industrial Approval Column A and Column B water quality criteria (Table 6.2). However, as all wells are located more than 10 m from a watercourse or waterbody, the following discussion only focusses on comparisons of the GCDWQ and IA Column B criteria.

The pre-development groundwater quality in the vicinity of the Open Pit is summarized on Figure 6.9. Comparing Figure 6.9 to Figure 6.4 shows that the concentrations of the water quality parameters in the vicinity of the Open Pit have generally increased from pre-development to existing conditions. However, as groundwater is interpreted to flow toward the Open Pit at these wells, these increases appear to be due to geochemical changes in the soil and bedrock as the groundwater flows towards the Open Pit. Consistent with the pre-development period, the mean concentrations of arsenic and manganese exceed the GCDWQ and IA Column B criteria, and the maximum concentrations exceed the criteria for lead and mercury.

The groundwater in the vicinity of the WRSA is summarized on Figure 6.10. Comparing Figure 6.10 to Figure 6.5 shows that the concentrations of the water quality parameters in the vicinity of the WRSA have generally increased from pre-development to existing conditions. However, consistent with the pre-development period, the mean concentrations of manganese, and the maximum concentrations of arsenic are the only parameters to exceed the GCDWQ and IA Column B criteria.

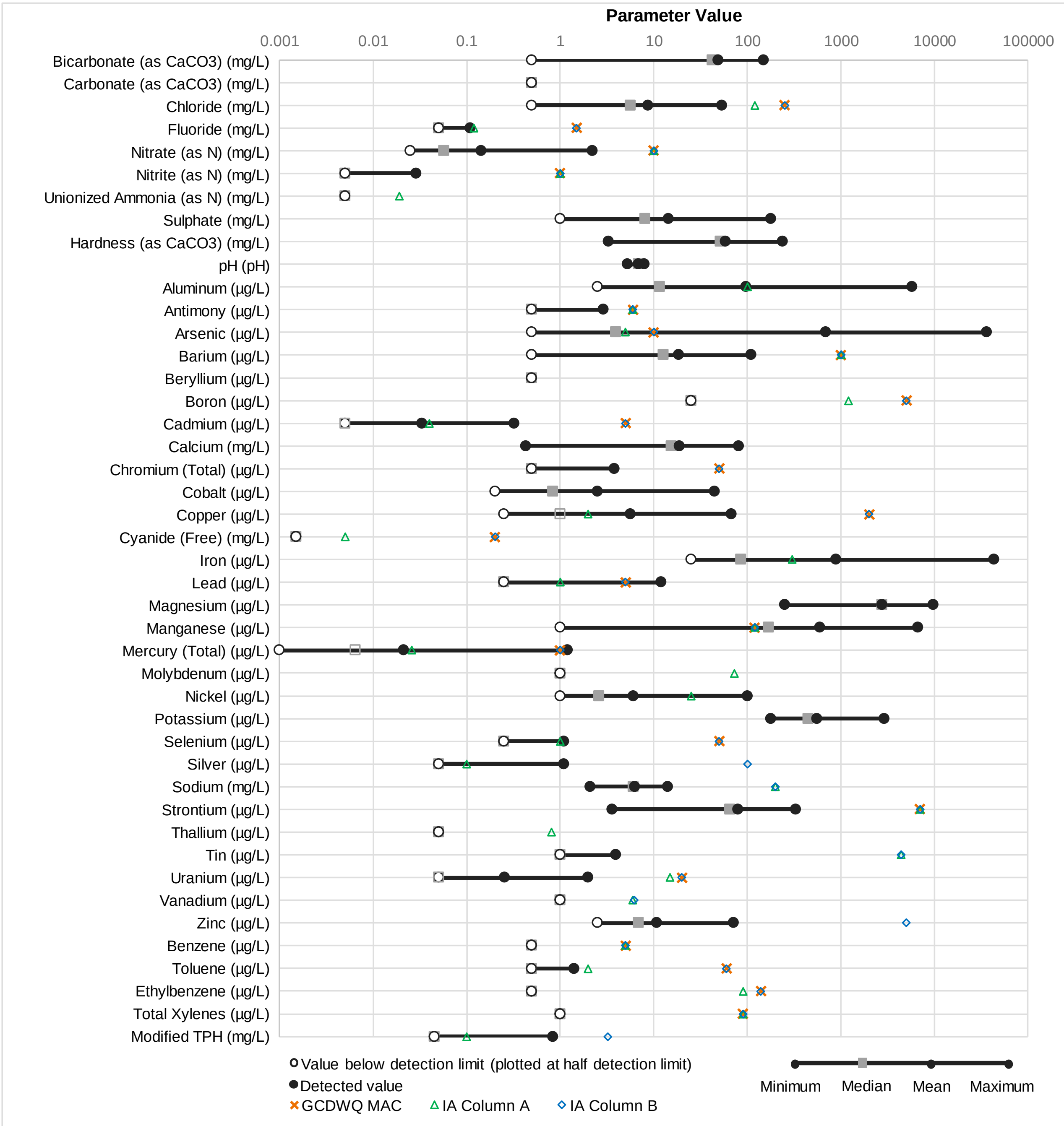

Figure 6.10 Summary of Water Quality in OPM-Series Wells during Operation

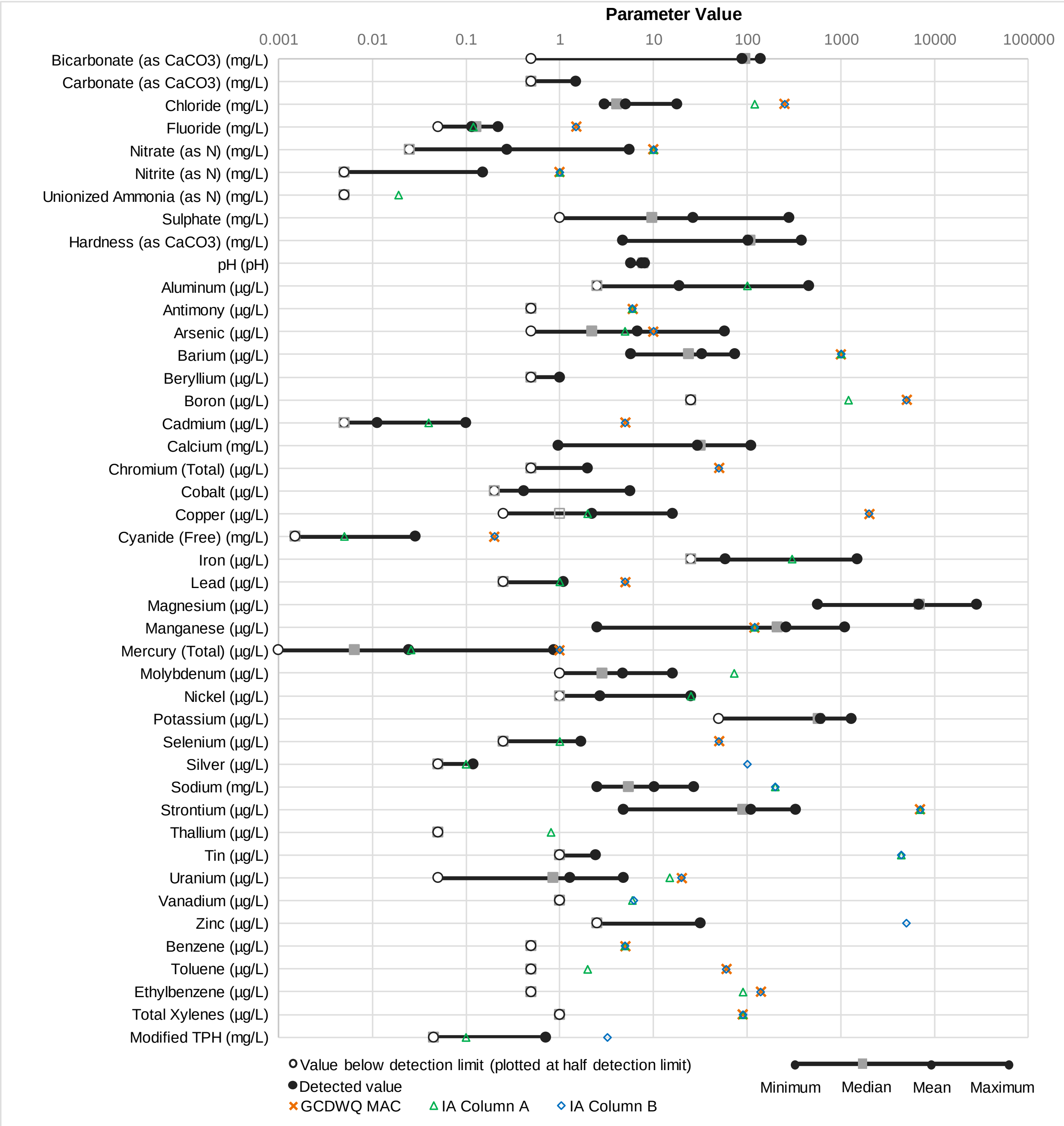

Figure 6.11 Summary of Water Quality in WRW-Series Wells during Operation

Dissolved parameters that exceeded the applicable guidelines in Table 6.2 and/or the action level values of the GWCP (Stantec 2019a; SD3) in groundwater samples collected in 2020 from one or more of the OPM-series and/or WRW-series monitoring wells are summarized below.

- Well OPM-3A had a copper concentration above the Threshold 2 action level in Q4 2020
- Well OPM-7B had conductivity and chloride concentrations above the Threshold 2 action level in Q3 and Q4 2020
- Well WRW-4A had chloride concentrations above the Threshold 2 action level throughout 2020
- Well WRW-5A had sulfate concentrations above the Threshold 2 action level in Q3 and Q4 2020, and conductivity, and chloride and sodium concentrations throughout 2020
- Well WRW-5B had arsenic concentrations above the Threshold 2 action level in Q4 2020, and conductivity and chloride concentrations in Q3 and Q4 2020

The groundwater conditions associated with these wells are currently being reviewed, and potential action plans to mitigate these trends should they be required, will be developed, and will be implemented in consultation with NSECC.

6.5 PROJECT INTERACTIONS WITH GROUNDWATER RESOURCES

Project activities that might interact with groundwater resources for each potential effect are identified in Table 6.4.

Table 6.4 Project Interactions with Groundwater Resources

Project Activities	Change in Groundwater Quantity	Change in Groundwater Quality
In-Pit Tailings Disposal		
Realignment of Tailings Line from TMF	-	-
Deposition/Disposal of Tailings	X	X
Water Management	X	X
Reclamation and Decommissioning	X	X
Waste Rock Storage Area Expansion		
Site Preparation	-	-
Operation of the WRSA	X	X
Water Management (e.g., modification of water drainage structures; relocation of monitoring well)	X	X
Reclamation and Decommissioning	X	X
Clay Borrow Area		
Site Preparation	-	-
Operation of Clay Borrow Area	X	-
Water Management	-	-

Table 6.4 Project Interactions with Groundwater Resources

Project Activities	Change in Groundwater Quantity	Change in Groundwater Quality
Reclamation and Decommissioning	-	-
New Plant Access Road		
Site Preparation	-	-
Operation of Road for Site Traffic	-	-
Reclamation and Decommissioning	-	-

6.5.1 In-Pit Tailings Disposal

Tailings from the process plant will be deposited into the exhausted Open Pit, which will have been dewatered as part of the ore extraction.

During decommissioning/closure, as surface water runoff from the Project is directed to the Open Pit. As the Open Pit fills, groundwater levels will slowly rise, and changes to groundwater flow direction and discharge locations are expected. The approved Touquoy EA stated that the Open Pit would be allowed to fill naturally with water over a period of time through precipitation, surface flow, and groundwater inflow. No change to this method is planned following the deposition of tailings, except that the timeframe 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.

The deposition of tailings into the exhausted Open Pit has the potential to interact with groundwater quality around the Open Pit, as well as water quality in Moose River from groundwater seepage into the river. Groundwater in the filled Open Pit has the potential to seep to Moose River during the post-closure phase of the Project.

6.5.2 Waste Rock Storage Area Expansion

Expansion of the WRSA has potential to affect groundwater recharge and consequently groundwater quantity and/or flow.

Runoff and seepage collection ditches and ponds located around the perimeter of mine infrastructure direct much of this water to the TMF tailings pond for treatment. Through subsurface flow pathways and seepage discharge, a minor percentage of the seepage from the WRSA may bypass the seepage collection system and report to adjacent surface water features. Thus, groundwater seepage from the expanded WRSA may result in changes to groundwater quality.

Closure of water management facilities will result in the removal of contact water collection systems that may result in changes to the fate and flow of groundwater originating from the WRSA. These changes will extend into the post-closure phase and reach a steady-state condition once the Open Pit is filled.

6.5.3 Clay Borrow Area

Operation of the Clay Borrow Area has potential to lower the water table locally within the footprint of the Clay Borrow Area. However, these effects will be localized within the development area of the Clay Borrow Area due to the low hydraulic conductivity of the clay materials.

6.6 MITIGATION

In addition to the standard management and monitoring measures to be implemented for the Project as discussed in Section 3.0, the following specific measures will be implemented to reduce or eliminate adverse effects on groundwater resources:

- Limit construction footprint (i.e., PDA) to the extent possible to reduce the potential for reductions in groundwater recharge and limit the number of watersheds overprinted by the PDA.
- Use standard construction methods, such as seepage cutoff collars, where trenches extend below the water table to mitigate preferential flow paths.
- Use standard bedrock grouting methods on high permeability fractures along the wall of the Open Pit to prevent migration of groundwater. Additional characterization of the hydrogeological parameters in the vicinity of the Touquoy Open Pit are currently planned for the summer of 2021, to confirm the properties of the faults and identify potential high permeability fractures.
- Use standard management practices throughout the Project, including drainage control and excavation dewatering.
- Maintain existing contact water and seepage collection ditches and/or install additional contact water and seepage collection ditches around the perimeter of the expanded WRSA as necessary to mitigate the migration of seepage from this mine infrastructure during Project operation.
- Maintain existing non-contact water diversion berms around the perimeter of the Open Pit to prevent the migration of clean runoff from the Open Pit during Project operation.
- Geochemical considerations will be part of the cover design for the WRSA to mitigate ARD generation.
- Implement the Project-specific GWCP (Stantec 2019a).

6.7 ASSESSMENT OF RESIDUAL EFFECTS

6.7.1 Change in Groundwater Quantity

6.7.1.1 In-pit Tailings Disposal

The groundwater flow model (Section 6.4.1.1; Appendix D.1) was used to predict the groundwater inflow rates to the Open Pit during the filling of the Open Pit with tailings and water. The filling of the Open Pit was simulated by adding tailings to the model, and then predicting the inflow rates to the pit lake above the tailings over time. The predicted inflow rates relative to the Touquoy pit lake stage during filling are presented on Figure 6.12. As shown, the inflow rates decrease from 768 m^3/d when the Touquoy pit is fully dewatered (i.e., pit lake stage elevation of -25 m CGVD2013), to 373 m^3/d at a pit stage elevation of 108 m CGVD2013, at which point the pit lake will overflow to Moose River through an engineered spillway.

The drawdown at the end of Open Pit filling (i.e., when the pit lake stage elevation is 108 m CGVD2013, representing the end of the closure phase) was simulated using the Touquoy groundwater model. The predicted steady-state groundwater drawdown contours for the conditions when the Open Pit is full are presented on Figure 6.13, and the water table contours are presented on Figure 6.14. As presented on Figure 6.12, the groundwater flow to the Open Pit remains at 373 m^3/d because the 108 m CGVD2013 level is below the natural groundwater elevation within the development area of the Open Pit. However, at this elevation, there are both groundwater inflows to and outflows from the Open Pit that are not observed with the fully dewatered Touquoy pit (i.e., where no outflows are observed, and the inflow condition dominates).

The net baseflow to Moose River at SW-2 under pit full conditions is simulated to be 29,608 m^3/d. Compared to the existing conditions, the groundwater inflows to the Open Pit filled to 108 m CGVD2013 is anticipated to increase the baseflow in Moose River at SW-2 by 249 m^3/d.

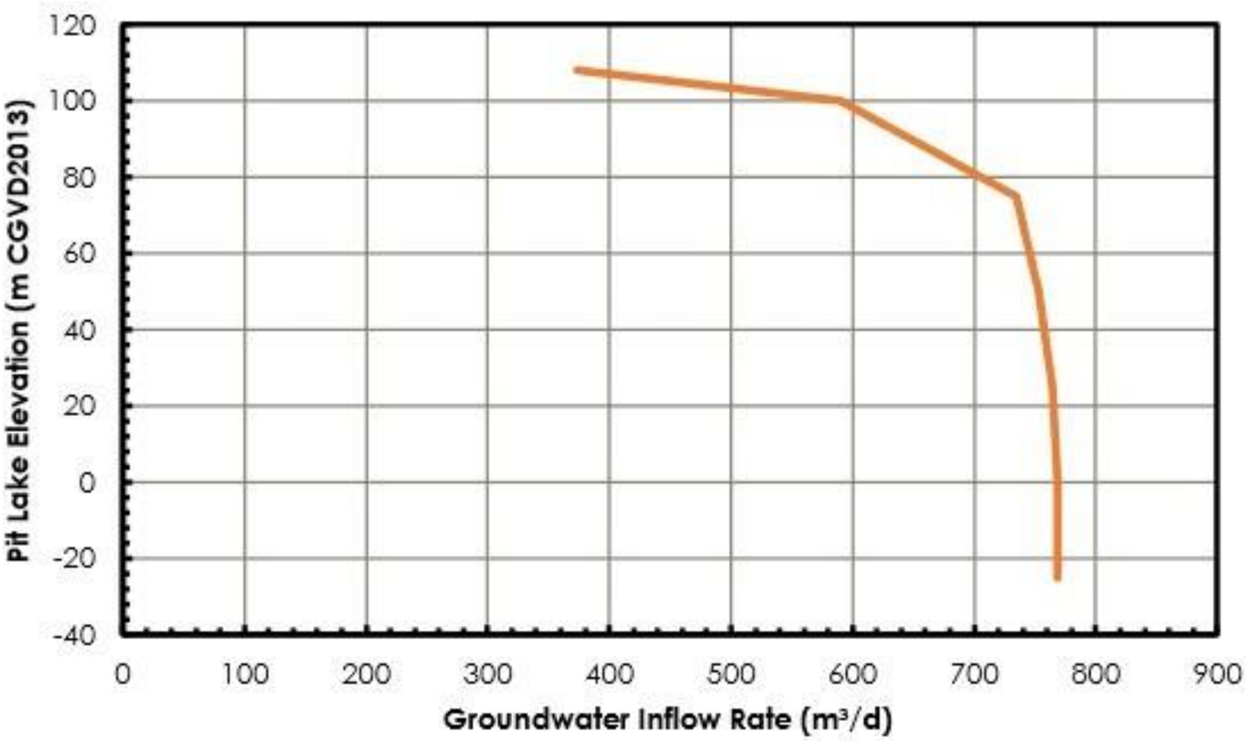

Figure 6.12 Groundwater Inflow Rates to the Open Pit During the In Pit Filling

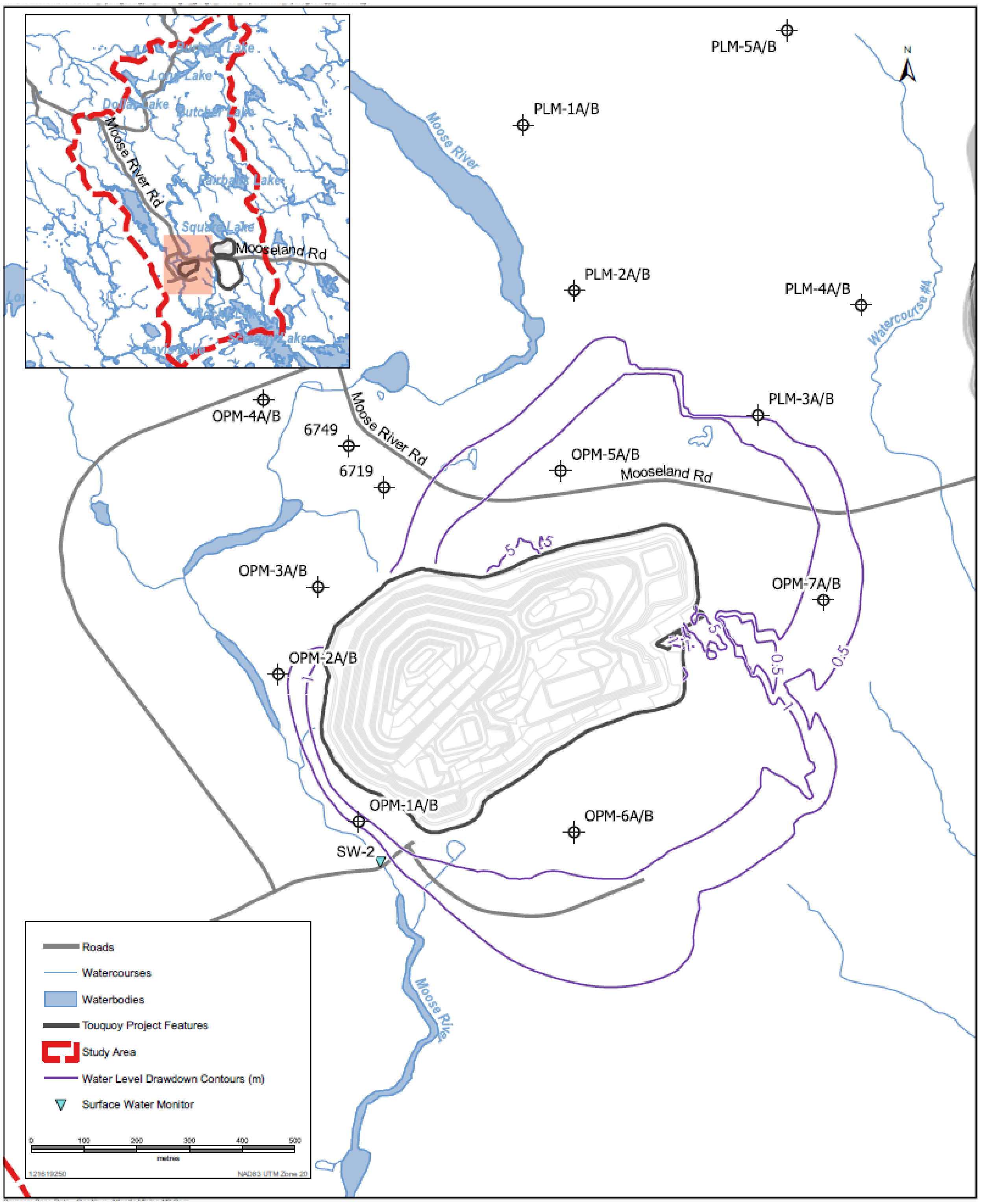

Figure 6.13 Predicted Drawdown Contours from Filled Open Pit at Touquoy Mine Site Following Deposition of Tailings

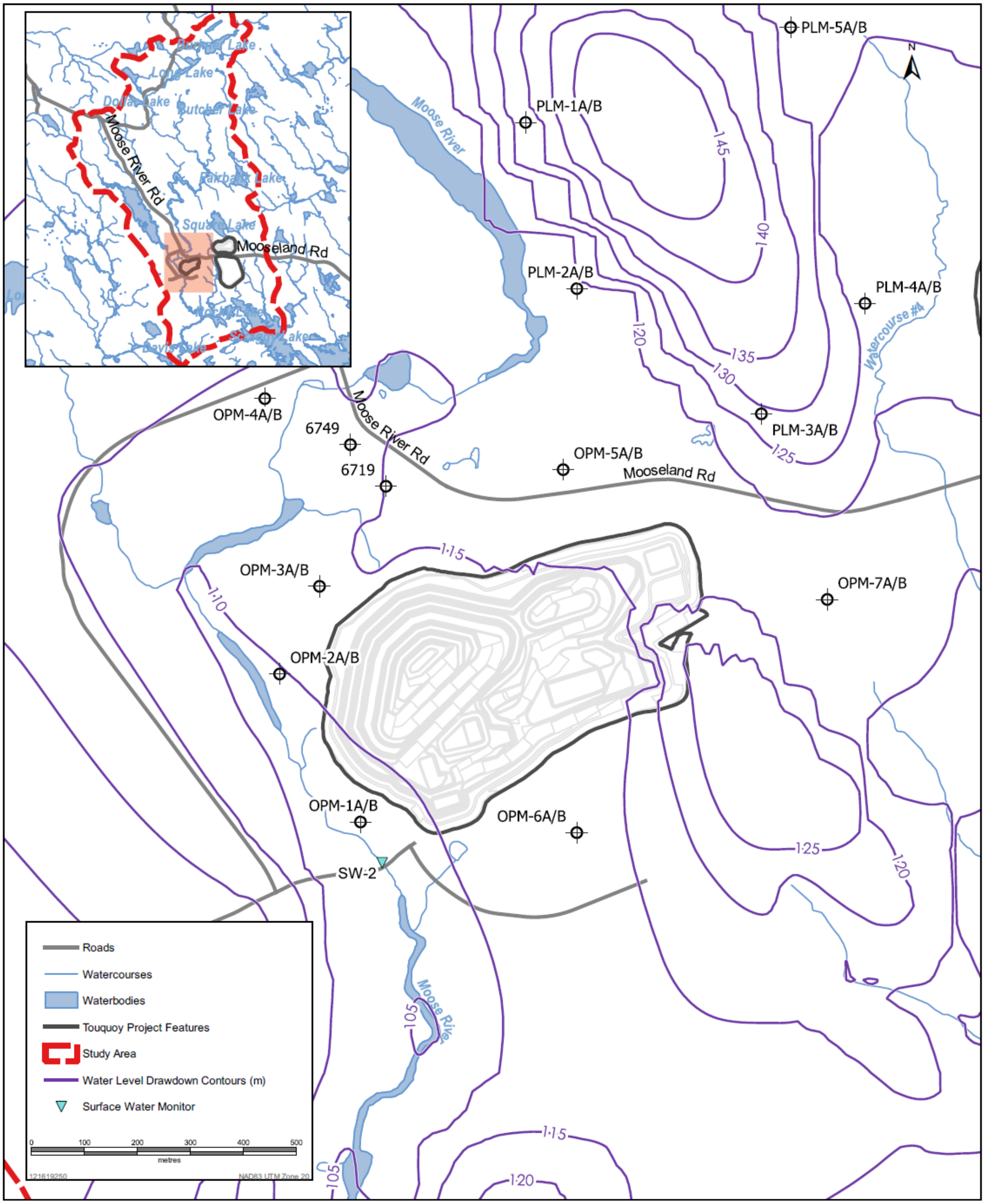

Figure 6.14 Water Table Contours at End of In-Pit Tailings Disposal Operation (Pit Lake Full)

6.7.1.2 Waste Rock Storage Area Expansion

The groundwater flow model prepared to assess the in-pit tailings disposal for the Project was modified to support the assessment of the effects of the proposed expansion of the Touquoy WRSA, as presented in Appendix D.2. The previously completed groundwater modelling for the Approved Project was updated to characterize the effects of seepage from the expanded WRSA on groundwater resources and the potential rate of groundwater flow to surface water features at the site. The updated groundwater modelling study (Appendix D.2) includes updates to the steady-state groundwater flow model of the existing Open Pit at full extent (i.e., to incorporate the seepage from the WRSA at full extent) as well as updates to the steady-state groundwater flow model to incorporate the seepage from the expanded WRSA at full extent.

The infiltration through the base of the WRSA has the potential to migrate through groundwater to surface water features, including the perimeter ditches for the WRSA and TMF, or to nearby watercourses or lakes. The groundwater flow model was used to better understand the fate of groundwater that originates from the WRSA and to estimate discharge rates to the receiving environment. A forward particle tracking approach was used, where a particle was released from each model node within the WRSA. The travel paths of the particles were simulated through the model domain until they arrived at a receptor, such as a lake or stream.

The estimated groundwater seepage to surface water features from the WRSA is shown on Table 6.5. The seepage rates presented on 6.5 are predicted conservatively high based on the assumption of initially saturated waste rock within the WRSA. The actual waste rock deposition will be at residual saturation and will require the wetting up of the pore space between grains in the waste rock before groundwater flow will occur which will delay the arrival of groundwater to the receiving environment.

Table 6.5 Comparison of Predicted Groundwater Seepage Rates (m^3/d) from WRSA to Surface Water Features

Parameter	Current WRSA	Expanded WRSA	Change (%)
WRSA Seepage Collection	206	270	31%
East Collection Pond	103	126	22%
West Collection Pond	31	33	6%
Watercourse #4[1]	54	126	133%
TMF Seepage Collection	65	70	8%
Square Lake	3	0	-100%
Fish River	44	46	5%
Tributary to Fish River	16	18	13%
Total	**522**	**689**	**32%**

Note:
[1] The mean annual flow in Watercourse #4 is 4,139 m^3/d, and the groundwater baseflow contribution from the expanded WRSA is 3.0% of the mean annual flow, versus 1.5% for the current WRSA.

As shown in Table 6.5, groundwater seepage from the WRSA is simulated to migrate toward the WRSA seepage collection ditches and associated collection ponds, Watercourse #4 (to the west), Fish River and its tributary (to the east), the TMF seepage collection ditches, and potentially to Square Lake. The majority of the flow is captured by the WRSA seepage collection ditches and associated collection ponds for both scenarios. The clay-lined East and West Collection Ponds are predicted to intercept some groundwater flow from the WRSA, however the seepage rate is limited by the presence of the clay.

As shown in Table 6.5, the total groundwater seepage for the expanded WRSA is estimated to be 32% greater than that for the current WRSA. This results in increased flows to the downgradient water features except Square Lake. The expansion of the WRSA to the north results in the movement of the WRSA seepage collection ditch closest to Square Lake at a deeper depth than the current IA design. This deeper ditch is predicted to intercept the small volume of water that was predicted to migrate toward Square Lake under the current IA conditions.

As shown in Table 6.5, the groundwater seepage for the expanded WRSA is estimated to be 133% greater than that for the current WRSA, based on the current WRSA seepage ditch design which essentially is a berm on grade along the western portion of the expanded WRSA. While the percentage of change appears high, it is small in both scenarios for groundwater flow discharging to Watercourse #4. The mean annual flow in Watercourse #4 is 4,139 m^3/d, and the groundwater baseflow contribution from the expanded WRSA is 3.0% of the total flow, versus 1.5% for the current WRSA.

The design of the western portion of the seepage collection ditch for the WRSA expansion limits the amount of groundwater seepage collected on the western portion because the water table is simulated to be below the bottom of the ditch. However, deepening the WRSA seepage collection ditch along the western portion of the WRSA can reduce the seepage to Watercourse #4, should the groundwater seepage need to be mitigated in future. With mitigation and environmental protection measures, the residual effect of a change in groundwater quantity is predicted to be not significant, because the extent of groundwater drawdowns during operation and closure of the Project components are located within the development area of the site, and will not result in changes to well yields at existing or future groundwater users. Changes to groundwater flow rates to surface water features are minor compared to the surface water flow rates, and are assessed with changes to surface water flows in the Surface Water VC (Section 7.0).

6.7.2 Change in Groundwater Quality

6.7.2.1 In-pit Tailings Disposal

The potential impacts to groundwater quality associated with in-pit tailings disposal are anticipated to be minor in nature and localized to within a short radius of the flooded Open Pit. Tailings will be subject to cyanide destruction at the process plant before flowing to the exhausted Open Pit. Cyanide destruction to cyanate is proven 99.5% effective (CRA 2007a, 2007b), which in turn is converted to ammonia and carbon dioxide. The majority of the residual cyanide reagent introduced to the tailings during ore processing will be passively degraded and hydrolyzed to carbon dioxide and ammonium during storage in the tailings pond. Similarly, this will be expected to occur for the tailings being stored in the Open Pit.

During the post-closure period, the deposition of tailings in the Open Pit will affect the water quality in the pit, including the pore water quality in the tailings within the Open Pit. This lower quality water has the potential to migrate toward Moose River via groundwater. The Touquoy groundwater model was used to simulate the migration of solutes from the Open Pit to Moose River. As described in the Touquoy groundwater modelling report (Stantec 2021b; Appendix D.1), the model simulated the release of water from the pore spaces in the deposited tailings, and the pit lake quality based on a relative contribution basis. This process simulates the transport of a conservative solute with a concentration of 1 mg/L through the groundwater to the receiving environment over time. The relative concentrations are multiplied by the source term concentrations for the parameters of primary concern (POPCs) in the Open Pit to predict the concentrations and mass loadings to the receiving environment over time. The anticipated distributions of the concentrations after 500 years are shown on Figure 6.15. The corresponding anticipated average concentrations of arsenic discharged to Moose River over the 500-year simulation period are shown on Figure 6.16. As shown on the figure, the average concentrations of arsenic are predicted to stabilize after approximately 150 years; this is also anticipated to be the case for the POPCs. The anticipated off-site migration of the plume south of Moose River is shown on Figure 6.16 and Table 6.6 presents the predicted average groundwater concentrations discharging to Moose River.

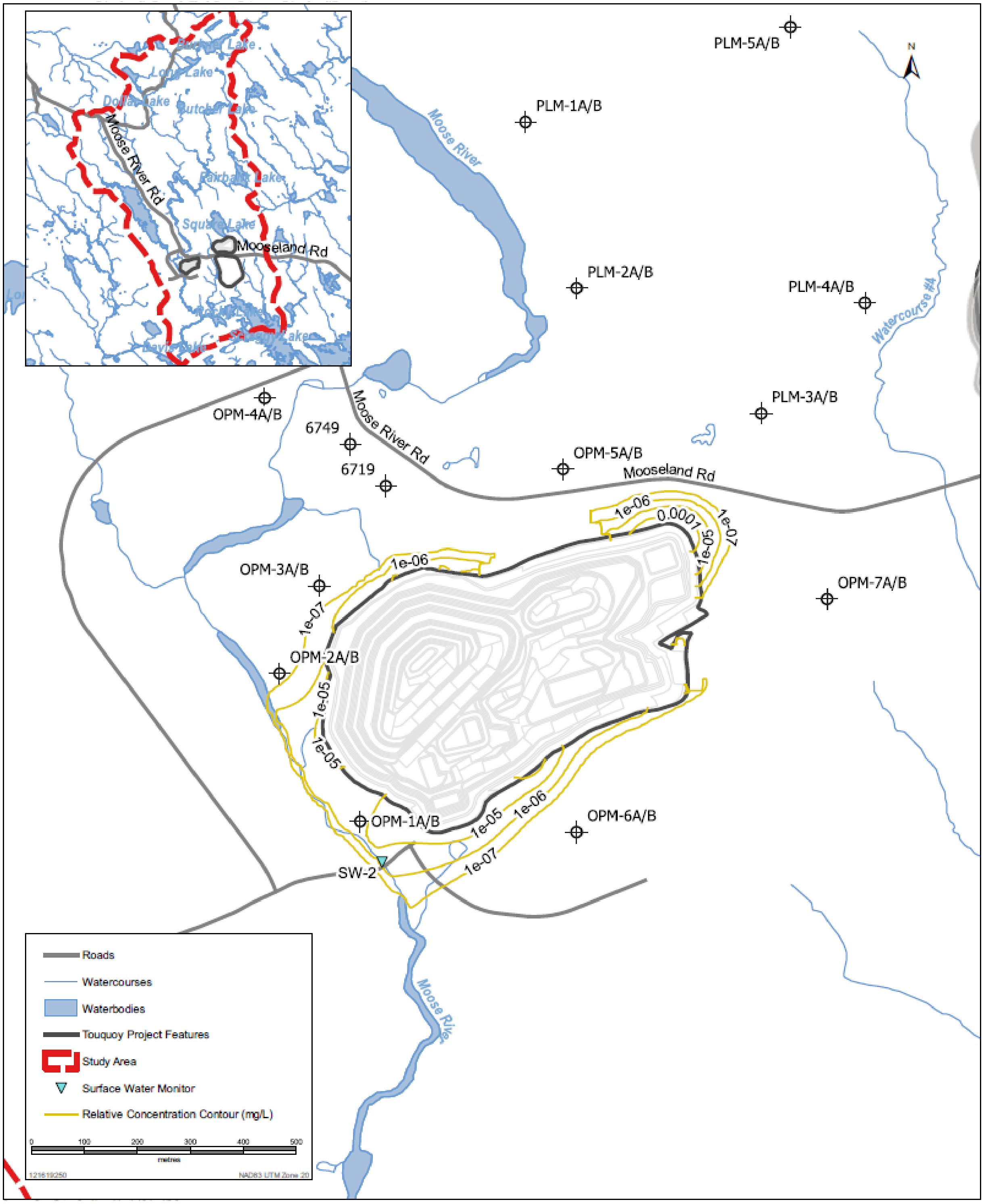

Figure 6.15 Relative Concentration Contours in Groundwater 500 Years Following Pit Lake at Stage 108 m

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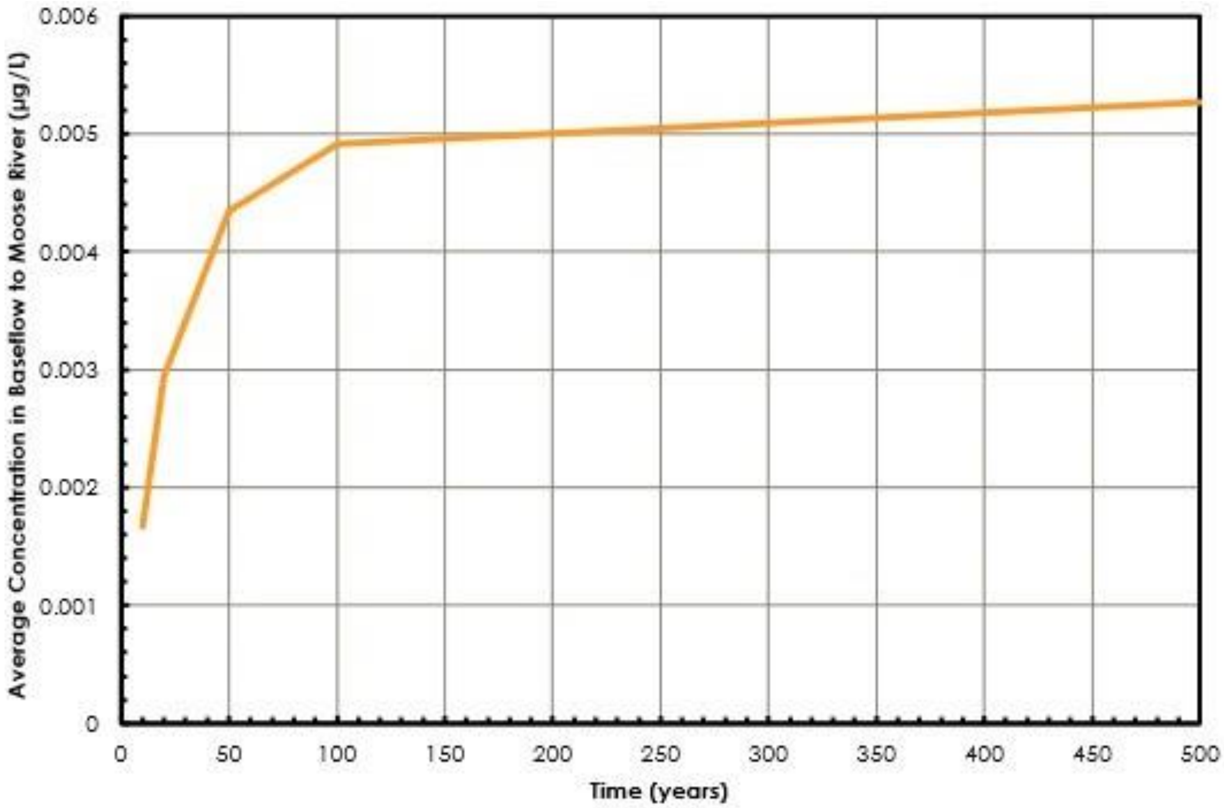


Figure 6.16 Simulated Average Concentrations of Arsenic Discharged to Moose River in Groundwater Seepage

Table 6.6 Predicted Average Groundwater Concentrations Discharging to Moose River

Parameter	Source Term Concentration (mg/L)	Average Concentration (mg/L)			
Elapsed Time (years)		5	60	150	500
Sulphate	897	4.9×10^{-4}	1.3×10^{-3}	1.4×10^{-3}	1.5×10^{-3}
Aluminum	0.0469	2.5×10^{-8}	6.6×10^{-8}	7.5×10^{-8}	8.0×10^{-8}
Silver	0.00001	5.4×10^{-12}	1.4×10^{-11}	1.6×10^{-11}	1.7×10^{-11}
Arsenic	3.07	1.7×10^{-6}	4.3×10^{-6}	4.9×10^{-6}	5.3×10^{-6}
Calcium	86.9	4.7×10^{-5}	1.2×10^{-4}	1.4×10^{-4}	1.5×10^{-4}
Cadmium	0.00002	1.1×10^{-11}	2.8×10^{-11}	3.2×10^{-11}	3.4×10^{-11}
Cobalt	0.0262	1.4×10^{-8}	3.7×10^{-8}	4.2×10^{-8}	4.5×10^{-8}
Chromium	0.0002	1.1×10^{-10}	2.8×10^{-10}	3.2×10^{-10}	3.4×10^{-10}
Copper	0.00937	5.1×10^{-9}	1.3×10^{-8}	1.5×10^{-8}	1.6×10^{-8}
Iron	0.0326	1.8×10^{-8}	4.6×10^{-8}	5.2×10^{-8}	5.6×10^{-8}
Mercury	0.000005	2.7×10^{-12}	7.1×10^{-12}	8.0×10^{-12}	8.6×10^{-12}
Magnesium	14.8	8.0×10^{-6}	2.1×10^{-5}	2.4×10^{-5}	2.5×10^{-5}
Manganese	0.37	2.0×10^{-7}	5.2×10^{-7}	5.9×10^{-7}	6.4×10^{-7}
Molybdenum	0.0603	3.3×10^{-8}	8.5×10^{-8}	9.6×10^{-8}	1.0×10^{-7}
Nickel	0.00685	3.7×10^{-9}	9.7×10^{-9}	1.1×10^{-8}	1.2×10^{-8}
Lead	0.0000248	1.3×10^{-11}	3.5×10^{-11}	4.0×10^{-11}	4.3×10^{-11}
Tin	0.00604	3.3×10^{-9}	8.5×10^{-9}	9.7×10^{-9}	1.0×10^{-8}
Selenium	0.000193	1.0×10^{-10}	2.7×10^{-10}	3.1×10^{-10}	3.3×10^{-10}
Tellurium	0.0000154	8.4×10^{-12}	2.2×10^{-11}	2.5×10^{-11}	2.6×10^{-11}
Uranium	0.00203	1.1×10^{-9}	2.9×10^{-9}	3.2×10^{-9}	3.5×10^{-9}
Zinc	0.0096	5.2×10^{-9}	1.4×10^{-8}	1.5×10^{-8}	1.6×10^{-8}
Weak Acid Dissociable Cyanide	0.005	2.7×10^{-9}	7.1×10^{-9}	8.0×10^{-9}	8.6×10^{-9}
Total Cyanide	0.087	4.7×10^{-8}	1.2×10^{-7}	1.4×10^{-7}	1.5×10^{-7}
Nitrate (as N)	0.053	2.9×10^{-8}	7.5×10^{-8}	8.5×10^{-8}	9.1×10^{-8}
Nitrite (as N)	0.11	6.0×10^{-8}	1.6×10^{-7}	1.8×10^{-7}	1.9×10^{-7}
Ammonia (as N)	34	1.8×10^{-5}	4.8×10^{-5}	5.4×10^{-5}	5.8×10^{-5}

The total groundwater seepage rate is simulated to contribute approximately 0.6% of the flow in Moose River; therefore, the mass loading of the primary compounds of concern are predicted to be low and are not anticipated to adversely affect the water quality in Moose River.

6.7.2.2 Waste Rock Storage Area Expansion

As described in Section 6.7.1, the groundwater flow model prepared to assess the in-pit tailings disposal for the Project was modified to support the assessment of the effects of the proposed expansion of the WRSA. The previously completed groundwater modelling for the Approved Project was updated to characterize the effects of seepage from the expanded WRSA on groundwater resources and the potential rate of groundwater flow to surface water features at the site. The updated groundwater modelling study (Stantec 2021c) includes updates to the steady-state groundwater flow model of the existing Open Pit at full extent (i.e., to incorporate the seepage from the WRSA at full extent) as well as updates to the steady-state groundwater flow model to incorporate the seepage from the expanded WRSA at full extent.

The infiltration through the base of the WRSA has the potential to migrate through groundwater to surface water features, including the perimeter ditches for the WRSA and TMF, or to nearby watercourses or lakes. The groundwater flow model was used to better understand the fate of groundwater that originates from the WRSA and to estimate discharge rates to the receiving environment. A forward particle tracking approach was used, where a particle was released from each model node within the WRSA. The travel paths of the particles were simulated through the model domain until they arrived at a receptor, such as a lake or stream.

There are no groundwater users in the vicinity of the WRSA, therefore the groundwater assessment is focused on characterizing the groundwater pathway to surface water. The results of the groundwater modelling includes the comparison of steady-state particle tracks to the final surface water receptors, as shown on Figure 6.17, and the estimated groundwater seepage to surface water features, as shown on Table 6.5. As discussed previously, the seepage rates presented on Table 6.5 are predicted conservatively high based on the assumption of initially saturated waste rock within the WRSA. The actual waste rock deposition will be at residual saturation and will require the wetting up of the pore space between grains in the waste rock before groundwater flow will occur which will delay the arrival of groundwater to the receiving environment.

As shown on Figure 6.17, the particles released from the WRSA are simulated to migrate toward the WRSA seepage collection ditches and associated collection ponds, Watercourse #4 (to the west), Fish River and its tributary (to the east), the TMF seepage collection ditches, and potentially to Square Lake. The majority of the flow is captured by the WRSA seepage collection ditches and associated collection ponds for both scenarios. The clay-lined East and West Collection Ponds are predicted to intercept some groundwater flow from the WRSA, however the seepage rate is limited by the presence of the clay.

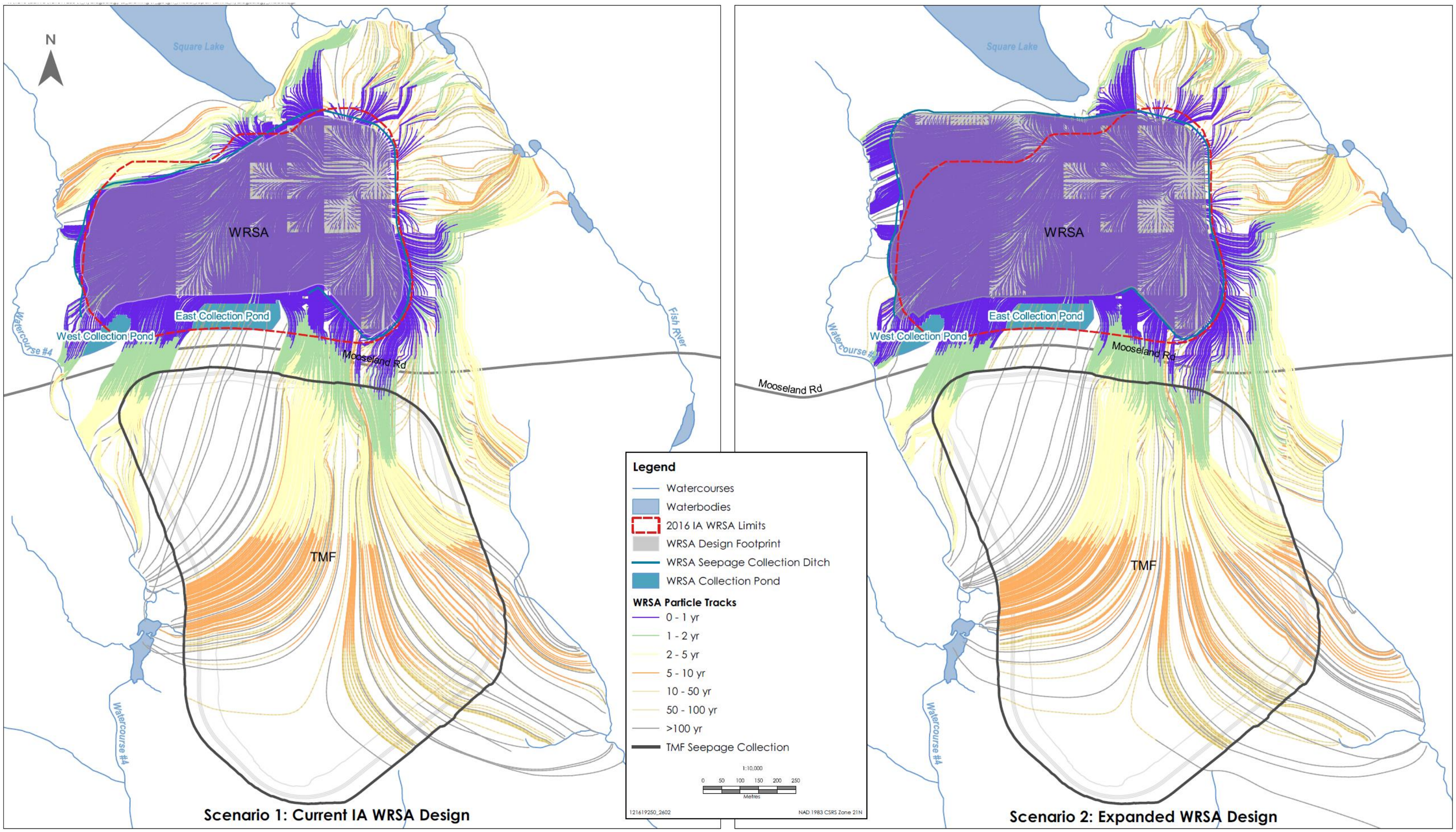


Figure 6.17 Comparison of Predicted Stead-State Particle Tracks Originating at Previously Approved WRSA and Proposed Expanded WRSA

As shown on Figure 6.17, a portion of the groundwater flow from the WRSA is predicted to travel through the bedrock beneath the TMF, and arrive at the seepage collection ditches around the perimeter of the TMF or to the watercourses downgradient of the TMF. As the presence of the TMF has not significantly altered the distribution of heads observed in the perimeter wells to date (Stantec 2021f), groundwater seepage from the TMF has not been included in the groundwater flow modelling for the WRSA. This is not anticipated to result in substantive changes to the estimates of seepage from the WRSA to the TMF seepage collection ditches.

With mitigation and environmental protection measures, the residual effect of a change in groundwater quality is predicted to be not significant, because the extent of changes in groundwater quality resulting from the WRSA expansion, or the in-pit disposal of tailings and will not result in groundwater quality that exceeds the GCDWQ for consecutive period of 30 days or more at existing or future groundwater users located outside of the PDA. Groundwater mass loading rates to surface water features are minor, and are assessed with changes to surface water quality in the Surface Water VC (Section 7.0).

6.8 FOLLOW-UP AND MONITORING

As indicated in Section 3.3, monitoring requirements related to.' groundwater quantity and quality are outlined in the existing Industrial Approval for the Approved Project and in the GWCP (Stantec 2019a) for the Project. Groundwater quantity is monitored with reference to monitoring well drawdowns and groundwater monitoring action levels are specified in the GWCP. Groundwater monitoring has been ongoing at the Touquoy Mine Site since 2016, and associated annual reports have been submitted to NSECC's ICE Division from 2017 to present. The objectives of the ongoing groundwater monitoring program are to:

- verify effects predicted in the original EARD And Focus Report
- confirm the continuing effectiveness of mitigation measures
- allow for adaptive management and identify the need for any new mitigation measure
- confirm compliance with regulatory approvals and requirements

Exceedances are reported according to the requirements of the Industrial Approval and the GWCP. These monitoring and reporting activities will continue following the proposed modifications to the Approved Project.

A groundwater monitoring well (WRW-1A/B) is located within the development area of the proposed WRSA expansion. Monitoring of this well is required as a part of the current Industrial Approval. It is recommended that a replacement well be installed to the north of the current wells, outside of the proposed WRSA limits, and that it be installed prior to decommissioning of WRW-1A/B. It is also recommended that a series of sampling events of both wells be completed to allow for data overlaps to be used relating the new well to the baseline data set of WRW-1A/B. A preliminary proposed location for the new well is shown on Figure 2.1; the exact location of the new wells will be finalized based on input from NSECC and submitted to NSECC for approval prior to installation.

7.0 SURFACE WATER RESOURCES

Surface Water Resources was selected as a valued component (VC) as it has the potential to both influence, and be influenced by, Project activities and for its importance to hydrological, ecological and socio-economic systems. Surface water is an integral part of the hydrological cycle and effects of the Project are will be considered for both surface water quantity and quality, and how changes in these two areas may affect human and ecological receptors. Surface water is an integral part of the local environment, providing habitat for fish, vegetation, and aquatic populations, and contributing to local socio-economic drivers. Surface water quality and quantity are provincially regulated through various legislative avenues within the *Environment Act* – these regulations help protect ecological components, as well as the health of the general public.

Surface water is closely linked to other VCs including Groundwater Resources (Section 6.0); Fish and Fish Habitat (Section 8.0); and Terrestrial Environment (Section 9.0) – the potential environmental effects of changes to surface water resources on these VCs are discussed in their respective sections.

7.1 POTENTIAL EFFECTS, PATHWAYS AND MEASURABLE PARAMETERS

Table 7.1 lists the potential Project effects on surface water resources and provides a summary of the Project effect pathways and measurable parameters to assess potential effects. Potential environmental effects and measurable parameters were selected based on review of Nova Scotia regulatory guidance, recent environmental assessments for similar projects in Nova Scotia and other parts of Canada, and professional knowledge and experience.

Table 7.1 Potential Effects, Effects Pathways and Measurable Parameters for Surface Water Resources

Potential Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Surface Water Quantity	• Project activities may result in changes to surface water quantity through increases or reductions to surface water flow volumes resulting from direct or indirect changes to surface cover and/or topography and/or changes in site water management (e.g., installation of ditching, pit dewatering),	• Mean annual and mean monthly stream flows (m^3/s) • Waterbody water levels (masl)
Change in Surface Water Quality	• Project activities may affect surface water quality due to runoff and/or seepage, process water discharges, sedimentation events during construction/ground disturbance activities, and spills of hazardous materials	• TSS concentrations (mg/L) • Concentrations (mg/L) of contaminants of potential concern

7.2 BOUNDARIES

The scope of the assessment is defined by spatial boundaries (i.e., geographic extent of potential effects) and temporal boundaries (i.e., timing of potential effects). Spatial boundaries for surface water resources were selected in consideration of the geographic extent over which Project activities, and their effects, are likely to occur on the VC. Temporal boundaries are based on the timing and duration of Project activities and the nature of the interactions with the VC. The spatial and temporal boundaries associated with the effects assessment for surface water resources are described in the following sections.

7.2.1 Spatial Boundaries

The following spatial boundaries were used to assess Project effects, including residual environmental effects, on surface water resources in areas surrounding the WRSA modification expansion, new Clay Borrow Area, relocated Plant Access Road and in-pit tails deposition (Figure 7.1):

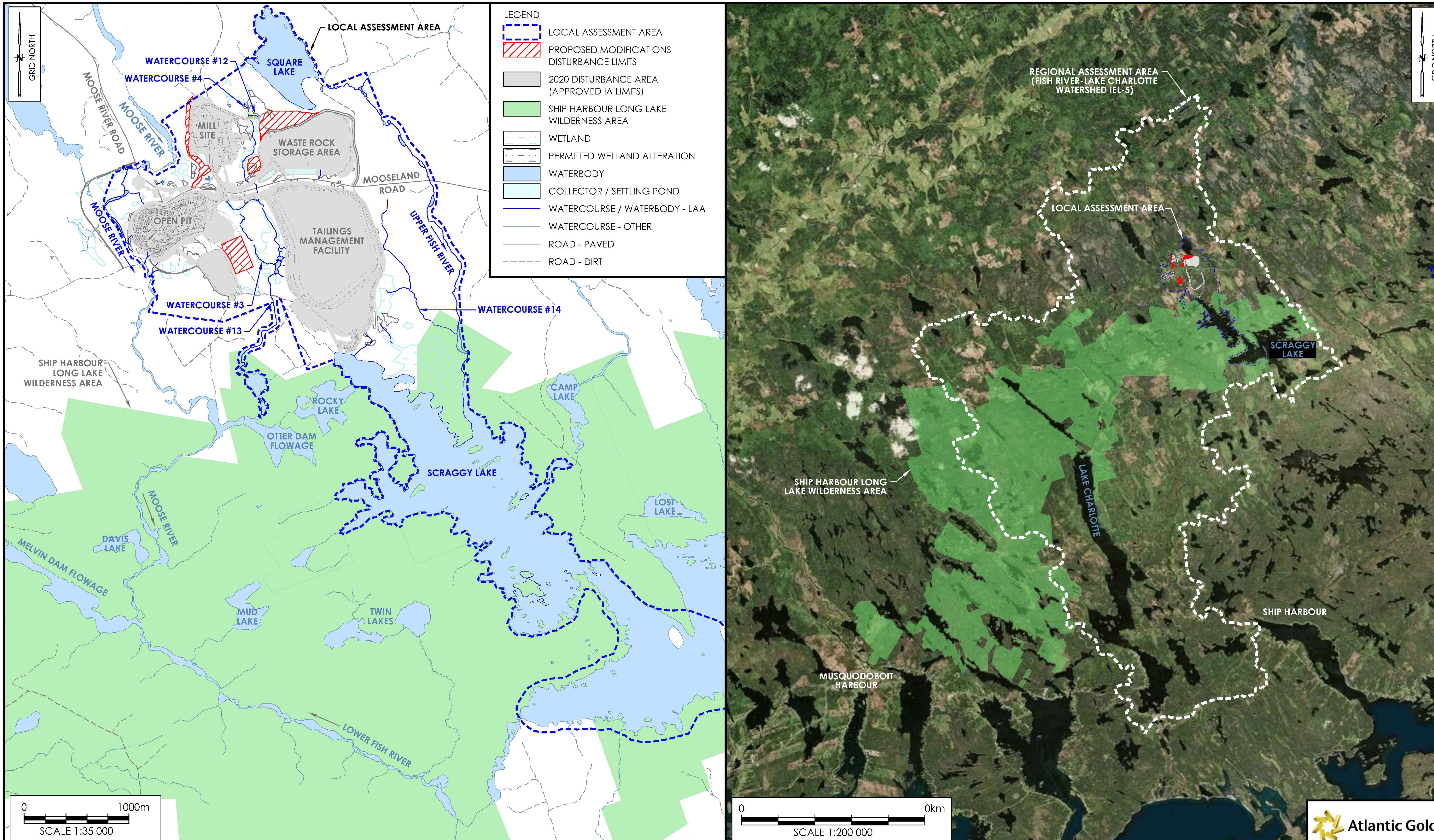
Project Development Area (PDA): The PDA represents the anticipated area of direct physical disturbance associated with construction, operation and decommissioning of the Project. It comprises the existing Open Pit, the WRSA expansion Area, the new Clay Borrow Area, the RoW of the new Plant Access Road, and the area required for ancillary features associated with these Project components (e.g., ditching, storage ponds, monitoring wells, parking lot security guard house).

Local Assessment Area (LAA): The LAA encompasses the area within which Project-related environmental effects can be predicted or measured for assessment. The LAA for surface water resources incorporates the PDA, Watercourse #4 to Otter Dam Flowage (overflow), Scraggy Lake, headwaters to Fish River, and Moose River to 120 m downstream of the spillway mixing zone as shown in Figure 7.1.

Regional Assessment Area (RAA): The RAA incorporates the PDA and LAA and encompasses the entirety of the Fish River-Lake Charlotte Watershed (IEL-5) which includes Moose River, Fish River, Square Lake, Scraggy Lake and Lake Charlotte.

7.2.2 Temporal Boundaries

The temporal boundaries for the assessment of effects on surface water resources include the construction phase, operation phase, and closure phase, which includes the decommissioning and reclamation stage, and post-closure stage; the project schedule is provided in Section 2.5



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LOCAL ASSESSMENT AREA AND REGIONAL ASSESSMENT AREA FOR SURFACE WATER RESOURCES

TOUQUOY GOLD PROJECT
HALIFAX COUNTY, NOVA SCOTIA

Client: ATLANTIC MINING NS INC.

Job No.:	121619250
Scale:	AS SHOWN
Date:	06-JUL-2021
Dwn. By:	JL
App'd By:	JR

Fig. No.: 7.1

Stantec

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7.3 SIGNIFICANCE DEFINITION

For the purposes of this EARD, significant adverse residual environmental effects on surface water resources focus on project-related changes to surface water quality and surface water quantity.

A significant adverse residual effect on surface water quantity is defined as a measurable Project-related change in hydrological regime that results in:

- Reductions of mean monthly flow (MMF) greater than 10% and where environmental maintenance flows can not be sustained.
- Contravention of a watershed management target including:
  - changes to flow greater 10% that increase erosion and sedimentation above regulatory guidance in waterbodies receiving surface water runoff
  - changes to flows that cause flooding downstream of the Project beyond existing conditions, or
  - changes to water levels outside the Project Area to a point that it affects the support of existing ecological functions (i.e., fish passage)

A significant adverse residual effect on surface water quality is defined as a measurable change in water quality that results in:

- A repeated or sustained exceedance of MDMER limits
- A repeated or sustained exceedance NS Tier 1 EQS thresholds applied in an Industrial Approval or a site-specific water quality guideline for the protection of aquatic life, except in cases where baseline water quality is already exceeding one or more thresholds.
- Contravention of a watershed management target including:
  - degradation of water quality that causes acute toxicity to aquatic life
  - changes the trophic status of a lake or stream, or
  - exceedance of the generally accepted total suspended solids (TSS) monitoring guideline (Canadian Council of Ministers of the Environment Canadian Water Quality Guidelines – Freshwater Aquatic Life [CCME CWQG-FAL]) applied to Project activities

7.4 BASELINE CONDITIONS

7.4.1 Regional Topography, Soils and Surficial Geology

The Touquoy Mine Site lies within the Fish River-Lake Charlotte secondary watershed (1EL-5), directly east of the large Musquodoboit River Valley system in central-southeastern Nova Scotia. The Fish River-Lake Charlotte watershed is drained by Fish River, Moose River, and respective tributaries. This area is in a region of the province characterized by rolling till plains, drumlin fields, extensive bedrock outcrops, and numerous freshwater lakes, streams, bogs, and wetlands. The area can be further characterized as having relatively low relief, hummocky type terrain. The watershed drains from a topographic high of approximately 180 m in elevation to 110 m at the confluence of Moose River and Fish River. The underlying bedrock geology is primarily greywacke and argillites, and slate, relatively impermeable and poorly jointed bedrock which results in poor groundwater recharge and retention of surface water on the land surface. Land cover is predominantly coniferous forest of red and black spruce (CRA 2007a). Located inland, the site is removed from the immediate coastal climatic influence of the Atlantic Ocean and is characterized by a seasonal variation of warmer summers and cooler winters.

7.4.2 Regional Climate

Climate affects the runoff characteristics and stream flows that define hydrologic conditions in the Project Area. Halifax Stanfield International Airport climate monitoring station (Climate ID: 8202250), the closest active station to the Project Area, was selected as providing an accurate representation of climate at the Project Area. A monthly summary of climate analysis is provided in Table 7.2. These data represent climate normals from the period of 1981 – 2010 (ECCC 2021).

Table 7.2 Monthly Regional Climate Normals, 1981 – 2010 (Climate ID: 8202250)

Month	Temperature (°C)	Snowfall (cm)	Precipitation (mm)	Speed (km/h)	Most Frequent Direction
Jan	-5.9	58.5	134.3	17.7	NW
Feb	-5.2	45.4	105.8	18.3	NW
Mar	-1.3	37.1	120.1	18.5	N
Apr	4.4	15.9	114.5	18.3	N
May	10	2	111.9	16.5	S
Jun	15.1	0	96.2	15.2	S
Jul	18.8	0	95.5	14.2	S
Aug	18.7	0	93.5	13.2	S
Sep	14.6	0	102	14.4	S
Oct	8.7	0.4	124.9	16	W
Nov	3.5	16.6	154.2	17.5	NW
Dec	-2.4	45.4	143.3	18.3	NW
Year	6.6	221.2	1396.2	16.5	S

AMNS has installed a meteorological station on site but has not yet gathered sufficient information to provide statistically significant climate data that can be used to calculate climate normals.

In general, the climate of the Project Area is characterized by a relatively moderate seasonal temperature regime, which fluctuates between a typical low of approximately -6 ºC in January and a high of 19 ºC in July and August. Precipitation is greatest in the fall and winter months. The amount of climate normal annual precipitation is approximately 1,400 mm.

Climate normals data (1981 to 2010) from the Halifax Stanfield International Airport climate station (ECCC 2021) are compared against monthly precipitation data for the same station for the time period of 2017-2020 (Table 7.3 below). In 2018 and 2019, the station reported monthly precipitation values in July and August as being approximately 18% to 50% less than climate normals from 1981-2010 (ECCC 2021). Monthly precipitation values in September were at or slightly below climate normals during these years.

Table 7.3 Monthly Precipitation Amounts, 2017 – 2020 (Climate ID: 8202250)

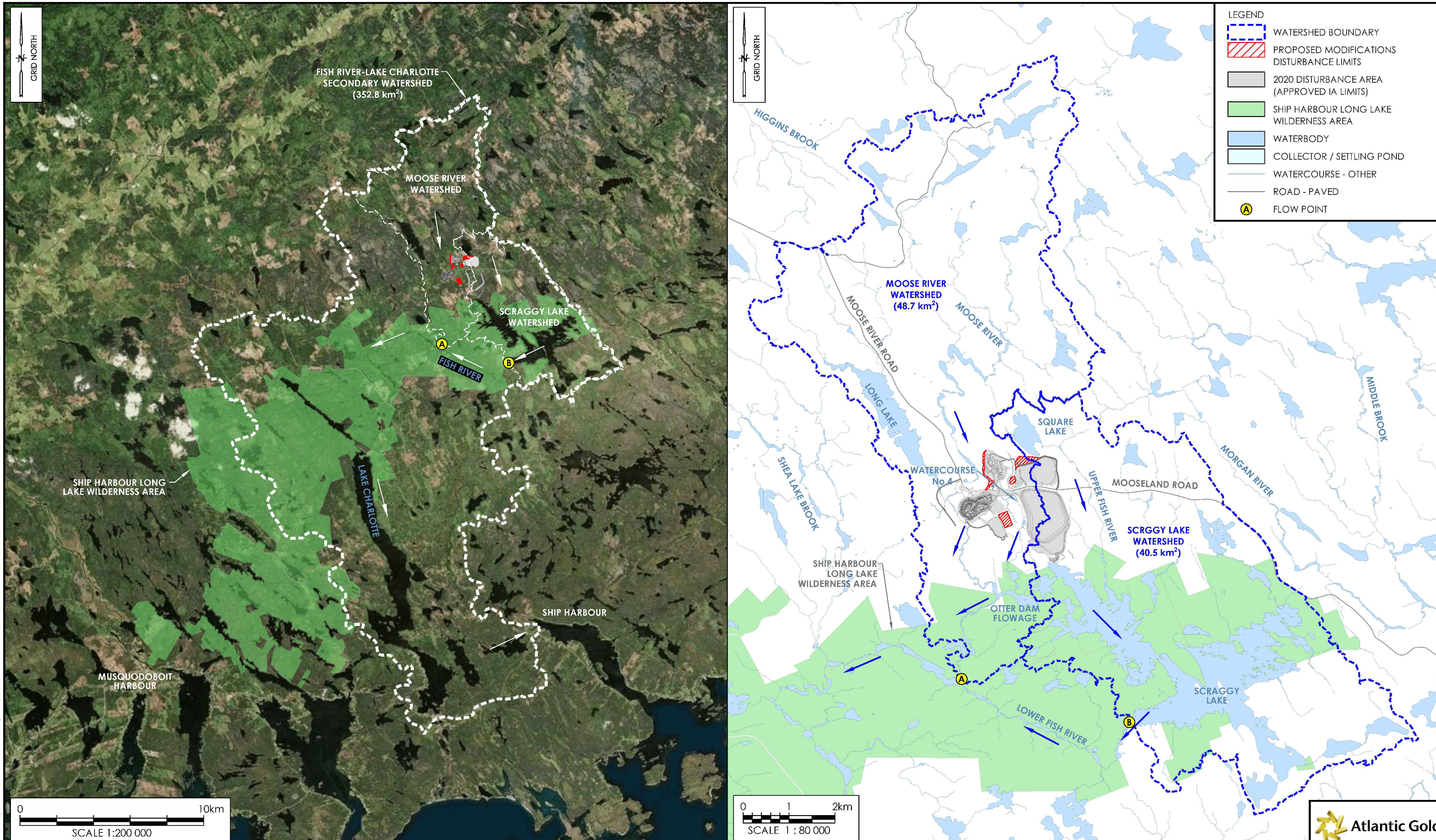
Month/Year	Monthly Precipitation (mm)					
	May	Jun	Jul	Aug	Sep	Oct
2017	156	**69.3**	145	93.7	142.1	**66.8**
2018	**63.1**	178.1	**65.9**	**58**	**101.8**	207.5
2019	**104.8**	166.6	**48.4**	**77.1**	**91.8**	**124.5**
2020	121.7	**33.2**	103	105.8	137	**116.4**
Climate Normals (1981-2010)	111.9	96.2	95.5	93.5	102	124.9

Note: **Bold** values and shaded cells highlight monthly precipitation below climate normals

7.4.3 Regional Watersheds

The Fish River-Lake Charlotte Watershed (1EL-5) is classified as a secondary watershed within the NS provincial watershed classification and is located south of the larger Musquodoboit River Watershed in central south-eastern NS. This watershed is primarily drained by Fish River, flowing from Square Lake south into Scraggy Lake, then west and south into Lake Charlotte, eventually emptying into Ship Harbour (Atlantic Ocean). A large portion (approximately 16.5 km^2) of the Fish River-Lake Charlotte watershed is protected land within the Ship Harbour Long Lake Wilderness Area, which extends from Scraggy Lake south-west towards Musquodoboit Harbour. Moose River and its tributaries drain the northernmost portion of the watershed to the confluence of Moose and Fish Rivers. The Moose River Drainage Basin and Scraggy Lake Drainage Basin are tertiary watersheds within the Fish River-Lake Charlotte Watershed. The Moose River Drainage Basin encompasses the majority of the Touquoy Mine Site and surrounding areas. This watershed is drained by Moose River and tributaries and covers an area of approximately 48 km^2. The Scraggy Lake Drainage Basin includes Square and Scraggy Lakes and encompasses a small portion of the eastern and southernmost Project Area. The watershed is drained by the Fish River headwaters and covers an area of approximately 40 km^2.

Regional watersheds are shown on Figure 7.2.



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3. IMAGE: BING (EARTHSTAR GEOGRAPHICS SIO).

PROJECT WATERSHEDS

TOUQUOY GOLD PROJECT
HALIFAX COUNTY, NOVA SCOTIA

Client: ATLANTIC MINING NS INC.

Job No.:	121619250
Scale:	AS SHOWN
Date:	06-JUL-2021
Dwn. By:	JL
App'd By:	SW

Fig. No.: 7.2

Stantec

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7.4.4 Regional Hydrology

The Moose River and Fish River are the two largest watercourses within the Fish River-Lake Charlotte Watershed. Neither watercourse is gauged by the Water Survey of Canada (WSC). Moose River flows north to south, from the headwaters of the Fish River-Lake Charlotte watershed to the confluence of Moose and Fish Rivers. It generally consists of a single channel with an average wetted width of 11.2 m (range is 4 to 40 m). Water depths in the main channel range from 0.10 to over 1.6 m.

Square Lake is located at the headwaters of Fish River. It has a surface area of approximately 33 ha and a maximum depth of approximately 4 m (CRA 2007a). The headwaters of Fish River flow from Square Lake to Scraggy Lake for approximately 3,650 m. From a review of aerial imagery, the river alternates between narrow reaches (~1 to 5 m in width) and larger stillwaters/steadies (~10 to 45 m in width) (Maxar 2020).

Scraggy Lake has a surface area of approximately 644.5 ha (CRA 2007a). The total estimated average volume of water within Scraggy Lake is approximately 21,542,0400 m^3 (GHD 2016c). Scraggy Lake is characterized by many small coves and islands and has a shoreline length of approximately 52,600 m (CRA 2007a). The lake outlet has been dammed and the result is a flooded, shallow basin (CRA 2007a). The majority of the lake is less than 6 m deep with an average depth of 3 m and a maximum depth of 14.0 m (CRA 2007a).

7.4.4.1 Regional Regression Analysis

A regional regression analysis is developed to assess flow rates in ungauged watersheds or where local flow records are of limited period in length. There are few gauging station datasets available in Nova Scotia near the site that meet primary selection criteria for regional regression analysis (e.g., length of flow record period, catchment area, distance to project site). The WSC stations selected for regional hydrology assessment are summarized in Table 7.4.

Table 7.4 WSC Regional Hydrology Stations

Station ID	Station Name	Drainage Area (km^2)	Years of Record	Record Period	Distance to Mine Site (km)
01DH003	Fraser Brook Near Archibald	10.1	26	1965-1990	45
01EJ004	Little Sackville River at Middle Sackville	13.1	39	1980-2018	65
01EE005	Moose Pit Brook at Tupper Lake	17.7	39	1981-2019	192
01EH006	Canaan River at Outlet of Connaught Lake	65.4	11	1986-1996	107
01DP004	Middle River of Pictou at Rocklin	92.2	54	1965-2018	58
01DG003	Beaverbank River Near Kinsac	96.9	98	1921-2018	60
01FA001	River Inhabitants at Glenora	193	55	1965-2019	150
01ED013	Shelburne River at Pollard's Falls Bridge	268	21	1999-2019	202

Table 7.4 WSC Regional Hydrology Stations

Station ID	Station Name	Drainage Area (km^2)	Years of Record	Record Period	Distance to Mine Site (km)
01EO003	East River St. Marys at Newtown	282	15	1965-1979	75
01EK001	Musquodoboit River at Crawford Falls	650	82	1915-1996	27

A regression analysis of the drainage area and mean annual flow of selected regional hydrometric stations is shown in Figure 7.3. A strong linear relationship between watershed area and annual flow represented by an R2 value of 0.9956. This means that watershed area, and by extension, change in watershed area can be used to estimate change in annual flow and does not require the addition of a lake attenuation factor sometimes included in empirical relationships to improve area to flow correlations.

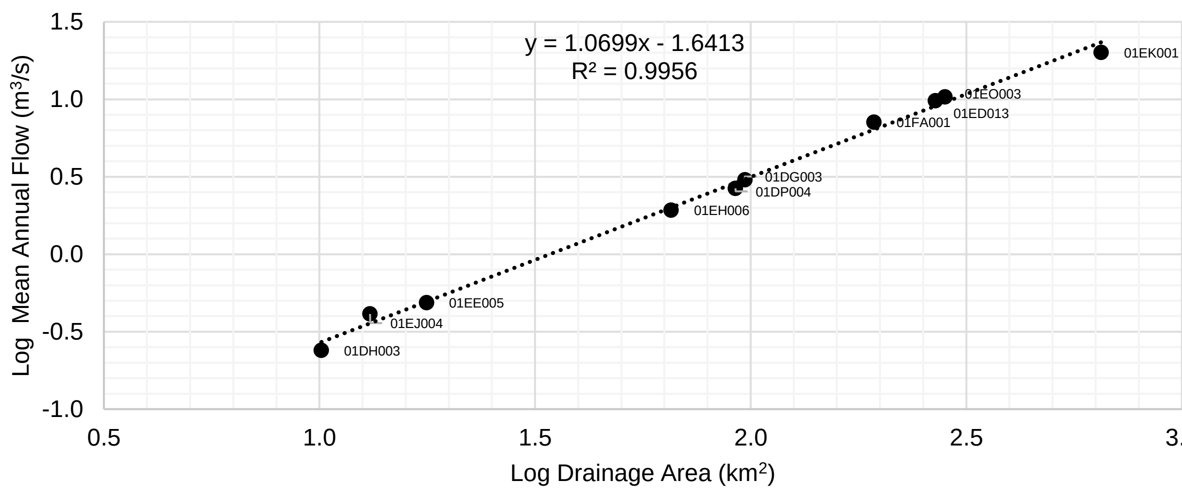


Figure 7.3 Regression Analysis of Regional Hydrometric Station Data

7.4.5 Local Site Operation and Water Usage

Mining of the Open Pit began in October 2017, with commercial production declared in March 2018. The Mine Site covers approximately 271 ha, of which the existing Open Pit is approximately 27 ha. The remaining site area comprises the WRSA, Plant Access and haul roads, Plant Site, TMF, and ancillary facilities. The Open Pit is located between Moose River to the west and an unnamed tributary (Watercourse #4) to the east. Both watercourses flow from north to south adjacent to the limits of the Open Pit. The Open Pit is 65 m from the bank of the Moose River at the nearest location and is actively dewatered during operation, with flow directed to the TMF.

Runoff from the Mill Facility is collected via perimeter ditching and conveyed to the Mill Storm Water Pond before being pumped to the TMF as part of processing. Runoff from the main site access road is conveyed to a sedimentation pond that is pumped to the WRSA collection ditch, and ultimately to the TMF for eventual treatment and discharge to Scraggy Lake. Discharge from the TMF undergoes further treatment in the ETP before being ultimately discharged to Scraggy Lake via a Polishing Pond and controlled and measured flow outlet. Scraggy Lake is the existing main receiving water body for the mine site. It is expected the ETP treats a typical annual volume of 1.55M m^3 at a nominal flow rate of 400 m^3/h over the period between January 2020 and February 2021. The ETP is operated as required to maintain water levels in the TMF, typically with minimal discharge during low flow summer months. There is no specific flow supplementation requirement from the ETP to Scraggy Lake as part of the IA.

Scraggy Lake is the current source of freshwater make-up supply for the active Touquoy Mill Facility. A water withdrawal permit (2017-103502-02) was issued by NSECC for water withdrawal from Scraggy Lake, permitting an average daily withdrawal of 720 m^3/day. Actual withdrawal rates over the period of record between January 2020 and February 2021 from Scraggy Lake are approximately 680 m^3/day. The Mill Facility reclaims water from the TMF as a closed loop, with tailings slurry discharged into the TMF and process water reclaim sourced from the TMF pond. The TMF is the main source of process water for operation of the Mill Facility. The average daily production rate for this period was 7,660 tpd. Table 7.5 presents a summary of estimated water use within the facilities along with inflows and outflows average over a one1-year period (i.e., between January 2020 and February 2021).

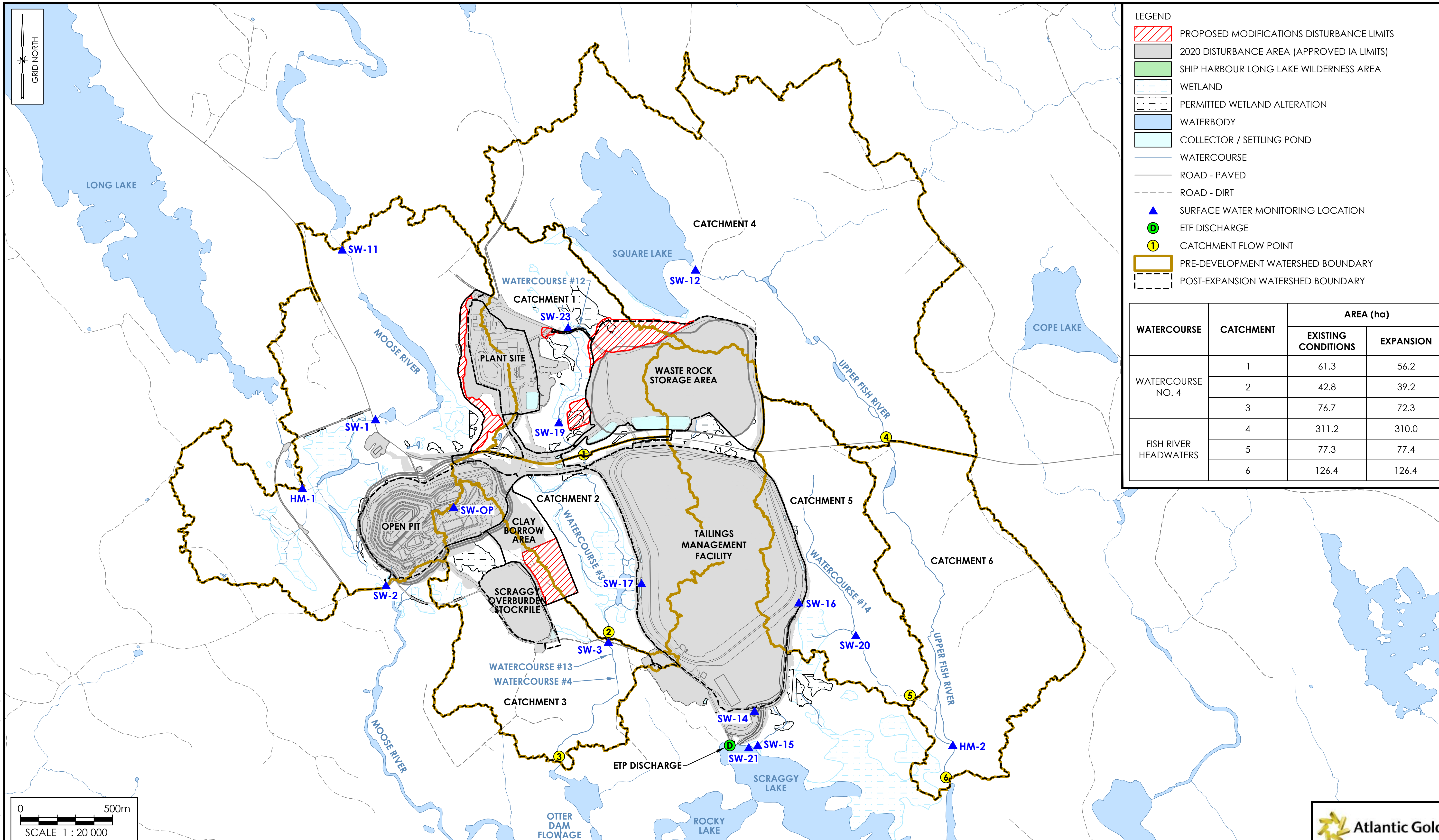
Table 7.5 Summary of Mine Site Process Water Use, Existing Conditions

Source	Water Flow from Source (m^3/d)
Mine Process Water During Operation	
Scraggy Lake Withdrawal for Process[1]	380
Reclaimed Water to the Mill Facility from the TMF	8,900
Moisture Content of Ore Going into Mill Facility	198
Water Lost to Evaporation and Process Losses at Mill Facility	-156
Water Discharged in Tailings Slurry to TMF	-8,808
TMF Water Balance	
WRSA Runoff	827
TMF Runoff	1,367
Open Pit Dewatering (Including Scraggy Overburden Stockpile Drainage and existing Clay Borrow Area)	1,518
Total Non-Process Flow to TMF	3,712
Outflow	
ETP Discharge	4,263

Note: [1] there is an additional 300 m^3/d of water withdrawal for domestic use at the Mill Facility

7.4.6 Local Catchment Areas

The catchment area of Moose River is approximately 48 km^2 ha and encompasses the existing Touquoy Mine Site and surrounding areas. The Project falls within two tertiary watersheds associated with two watercourses in proximity to the Mill Facility: Moose River (western) and the Fish River headwaters (eastern) flowing from Square Lake to Scraggy Lake. Each tertiary watershed has three sub-catchment areas associated within the PDA (Figure 7.4). Catchment areas 1, 2 and 3 are associated with Watercourse #4, an unnamed tributary to Moose River. Catchment areas 4, 5 and 6 are associated with the Fish River headwaters to Scraggy Lake. Current operations have primarily altered the catchment area boundaries of Watercourse #4 with lesser changes to the catchment area boundaries of the Fish River headwaters. A summary of catchment areas for both watercourses is provided in Table 7.6.



WATERCOURSE	CATCHMENT	AREA (ha) EXISTING CONDITIONS	AREA (ha) EXPANSION
WATERCOURSE NO. 4	1	61.3	56.2
	2	42.8	39.2
	3	76.7	72.3
FISH RIVER HEADWATERS	4	311.2	310.0
	5	77.3	77.4
	6	126.4	126.4

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

Reference:
1. PROVINCIAL BASE DATA REPRODUCED AND DISTRIBUTED WITH THE PERMISSION OF SERVICE NOVA SCOTIA & MUNICIPAL RELATIONS (SNSMR, 2006) AS PER THE TERMS OF USE OUTLINED IN THE UNRESTRICTED DATA USE LICENSE AGREEMENT FOR GEOGRAPHIC DATA.
2. SITE DATA PROVIDED BY ATLANTIC MINING NS INC. AND McCALLUM ENVIRONMENTAL.

SURFACE WATER MONITORING LOCATIONS AND PROJECT CATCHMENT AREAS

TOUQUOY GOLD PROJECT
HALIFAX COUNTY, NOVA SCOTIA

Client: ATLANTIC MINING NS INC.

Atlantic Gold

Job No.:	121619250
Scale:	1 : 20 000
Date:	06-JUL-2021
Dwn. By:	JL
App'd By:	SW

Fig. No.: 7.4

Stantec

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Table 7.6 Watercourse #4 and Fish River Headwaters Catchment Areas

Catchment No.	Watercourse	Location on Watercourse	Pre-Development Area (ha)	Existing Area (ha)
1	Watercourse #4	Mooseland Road	89.2	61.3
2		At SW-3	93.1	42.8
3		Otter Dam Flowage	97.4	76.7
Catchment Area Total			**279.7**	**180.8**
4	Fish River Headwaters	Mooseland Road	317.8	311.2
5		Confluence with Tributary	91.2	77.3
6		Scraggy Lake	126.4	126.4
Catchment Area Total			**535.4**	**514.9**

7.4.7 Local Hydrology

There are several watercourses and waterbodies located immediately adjacent to or within the development area of the existing Touquoy Mine Site. Moose River is located to the west of the existing Open Pit with the riverbank located approximately 65 m from the Open Pit at the closest location. Watercourse #4, a tributary to Moose River, flows north to south through the site between the Open Pit and TMF. The Fish River Headwaters flow adjacent to the site to the east. There is an unnamed tributary to Fish River which flows approximately 1,450 m before the confluence with Fish River adjacent to the eastern side of the TMF. Square Lake is located directly to the north of the WRSA. Scraggy Lake is located directly south of the TMF.

7.4.7.1 Local Streamflow

Seasonal streamflow measurements (typically May through October) have been undertaken since 2017 on Moose River at SW-11 and SW-2. A third gauged site, HM-1, was added in 2018 on the Long Lake tributary of Moose River upstream of SW-2 to improve the characterization of flows between SW-11 and SW-2. Streamflow measurements were initiated in Watercourse #4 in the spring of 2021 with the installation of three gauged sites at SW-23, SW-19, and SW-3. Streamflow measurement data are provided where available. Regional regression methods and prorated data sets are used to assess mean monthly flows and changes in flow regime based on the lack of adequate measured data record at these watercourses.

Moose River – Measured Flow Data

Stage discharge relationships (Table 7.7, below) were developed for gauged locations on Moose River in fulfillment of IA requirements using measured discharge and water level readings captured over a range of flow events between 2017 and 2021. The methodology used to conduct stream flow monitoring was in accordance *with ISO 748:2007E Hydrometry – Measurements of liquid flow in open channels using current meters or floats*.

Table 7.7 Stage-Discharge Relationships for Surface Water Monitoring Locations on Moose River

Location on Moose River	Discharge Equation	Regression Coefficient (R^2)
SW-11 (Upstream)	$Q = 43.079(wl)^{4.1818}$	0.9376
HM-1 (Long Lake Tributary)	$Q = 13.0036(wl)^{4.8114}$	0.9956
SW-2 (Downstream)	$Q = 8.7063(wl)^{3.4601}$	0.9747

Applying the developed discharge equations to measured water level data captured from in-situ transducers, flow rates are calculated for each gauged location. Mean monthly flows at the Moose River surface water monitoring locations are presented in Table 7.8, below, as average daily flow rates over the period of record. Data are shown for the seasonal measurement period of May through October using measured water level data captured over the gauged period of 2017 - 2020.

Table 7.8 Mean Monthly Flows Measured at Surface Water Monitoring Locations on Moose River

	Mean Monthly Flow from Measured Data, 2017 - 2020 (L/s)		
Month	**SW-11**	**HM-1**	**SW-2**
May	586	348	1,530
June	295	179	880
July	113	86	330
August	42	59	124
September	147	63	268
October	318	21	635

A comparison of calculated and estimated daily flows at SW-2 during the 2020 monitoring period of May through October are shown Figure 7.5, below. The flows at SW-2 were estimated from the sum of calculated flows at HM-1 and the calculated flows from SW-11 that have been prorated by the ratio of drainage areas of SW-2 and SW-11 ($DA_{SW-2} – DA_{HM-1})/DA_{SW-11}$). By prorating the data, this accounts for the small discrepancy in drainage area between SW-11 and SW-2. The vertical scale on Figure 7.5 is truncated at a maximum flow of 10 m^3/s.

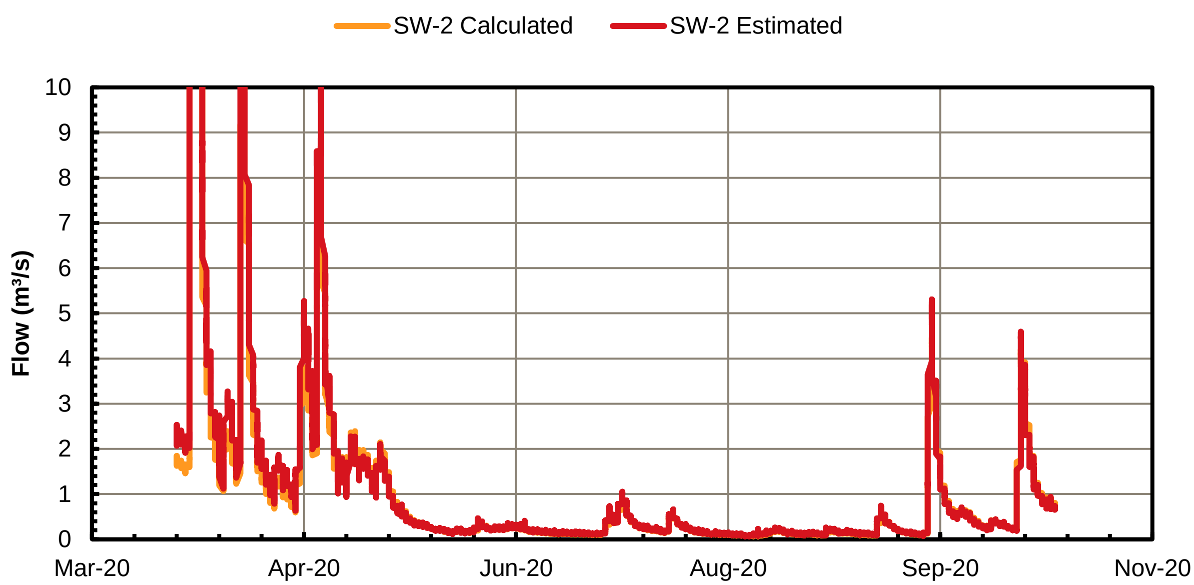


Figure 7.5 Observed and Estimated Flows at SW-2 on Moose River for 2020

Moose River – Regional Regression

Flow data for Moose River is estimated using the regional regression outlined in Section 7.4.4.1. The catchment area is associated with SW-11 and represents the contributing area to Moose River upstream of this location. Mean monthly flows for Moose River are shown in Table 7.9, below. Low flow months are July, August, and September with flows below 300 L/s during these months. The highest flows are in April at over 1,400 L/s. The mean annual flow is estimated at 735 L/s.

Table 7.9 Mean Monthly Flow in Moose River, Existing Condition

Parameter	Moose River Mean Monthly Flow (L/s)	Average Unit Discharge Over Period of Record (L/s/km2)
January	782.23	30.34
February	712.78	27.65
March	1060.92	41.15
April	1422.30	55.17
May	824.56	31.98
June	435.41	16.89
July	257.82	10.00
August	241.66	9.37
September	294.18	11.41
October	611.53	23.72
November	1,089.93	42.28

Table 7.9 Mean Monthly Flow in Moose River, Existing Condition

Parameter	Moose River Mean Monthly Flow (L/s)	Average Unit Discharge Over Period of Record (L/s/km2)
December	1,093.43	42.41
Mean Annual Flow	735.56	28.53
Catchment area (km^2)	25.78	-

Watercourse #4 – Regional Regression

Data collection at gauged locations in Watercourse #4 began in March 2021. Regional regression flow data for Moose River is prorated to the Watercourse #4 catchment area to estimate mean monthly flows for the watercourse (Table 7.10). At the Watercourse #4 catchment outlet, flows in July, August and September are below 20 L/s. Highest flows are during the month of April at approximately 100 L/s. The mean annual flow rate is estimated to be approximately 50 L/s.

Table 7.10 Prorated Mean Monthly Flow for Watercourse #4 and Catchments, Existing Condition

Month	Watercourse #4 Catchment	Catchment 1 - Mooseland Road	Catchment 2 - SW-3	Catchment 3 – Otter Dam
	Mean Monthly Flow (L/s)			
January	54.86	18.60	12.99	23.27
February	49.99	16.95	11.83	21.21
March	74.40	25.23	17.61	31.56
April	99.75	33.82	23.61	42.32
May	57.83	19.61	13.69	24.53
June	30.54	10.35	7.23	12.95
July	18.08	6.13	4.28	7.67
August	16.95	5.75	4.01	7.19
September	20.63	7.00	4.88	8.75
October	42.89	14.54	10.15	18.19
November	76.44	25.92	18.10	32.43
December	76.68	26.00	18.15	32.53
Mean Annual Flow	51.59	17.49	12.21	21.88
Catchment area (km^2)	1.808	0.613	0.428	0.767

7.4.8 Surface Water Quality

Surface water has been monitored in watercourses and waterbodies in proximity to the Touquoy Mine Site since 2016. Site operation began in 2017 and TMF discharge to Scraggy Lake in 2018. Monitoring that took place prior to commencement in October 2017 is considered representative of pre-development conditions. There are twelve surface water monitoring locations that are associated with streams and lakes local to the Touquoy Mine Site. A summary of surface water monitoring locations representative of surface water bodies in the project area are given in Table 7.11. Sampling requirements are as per the Industrial Approval and results of surface water monitoring are summarized in annual reporting completed by Stantec from 2016 through 2020. The most recent monitoring report is attached (SD 19).

Table 7.11 Surface Water Monitoring Locations (Lakes, Rivers and Tributaries) and Requirements as per IA (#2012-084244-A02)

Site	Location	Rationale	Location Description	Water Quality Parameters	Monitoring Frequency
SW-1	504325E, 4981604N	Background	Moose River – Upstream of Facility and Upstream of Moose River Road culvert.	General	Monthly
SW-2	504378E, 4980703N	Downstream – Near-field	Moose River – Downstream of Facility and Upstream of Bridge.	General	Monthly
SW-3	505587E, 4980396N	Downstream – Near-field	Unnamed Tributary (Watercourse #4) to Moose River Downstream of Facility.	General	Monthly
SW-11	504140E, 4982529N	Background	Moose River – Upstream of the Site to represent relatively un-impacted conditions upstream of the facility.	General	Monthly
SW-12	506060E, 4982420N	Background	Outlet from Square Lake.	General	Monthly
SW-13	507950E, 4976355N	Downstream – Far-field	Outlet from Scraggy Lake at Dam.	General	Monthly
SW-15	506397E, 49798321N	Downstream – Near-field	Outlet of unnamed Tributary to Scraggy Lake, at confluence with Scraggy Lake.	General	Monthly
SW-18	501475E, 4974281N	Downstream – Far-field	Fish River north of the Pughole and upstream of bridge.	General	Monthly
SW-19	505333E, 4981589N	Downstream – Near-field	Unnamed Tributary to Moose River (Watercourse #4) – upstream of the tailings pond, adjacent to the WRSA	General	Monthly
SW-20	506931E, 4980433N	Downstream – Near-field	East of the tailings impoundment on an unnamed tributary to Scraggy Lake.	General	Monthly
SW-21	506349E, 4979823N	Downstream – Near-field	In Scraggy Lake, at outlet of polishing pond emergency spillway.	General	Monthly
SW-23	505369E, 4982094N	Background	Unnamed Tributary to Moose River (Watercourse #4) upstream of Site to represent relatively un-impacted upstream conditions.	General	Monthly

Table 7.11 Surface Water Monitoring Locations (Lakes, Rivers and Tributaries) and Requirements as per IA (#2012-084244-A02)

Site	Location	Rationale	Location Description	Water Quality Parameters	Monitoring Frequency
Surface Water Quality Parameters to be Monitored (IA #2012-084244-08)					
Total Alkalinity, Dissolved Chloride, Colour, Hardness, Nitrate & Nitrite, Nitrate, Nitrogen Ammonia, Total Organic Carbon, Total Phosphorous, pH, Reactive Silica, Dissolved Sulphate, Turbidity, Conductivity, Aluminum, Antimony, Arsenic, Barium, Beryllium, Bismuth, Boron, Cadmium, Calcium, Chromium, Cobalt, Cyanate, Cyanide (WAD), Cyanide (Free), Thiocyanate, Copper, Iron, Lead, Manganese, Molybdenum, Nickel, Selenium, Silver, Strontium, Thallium, Tin, Titanium, Uranium, Vanadium, Zinc, Total Suspended Solids, Sodium, Potassium, Magnesium, Fluoride, Ion Balance, Mercury, Sulphate, Total Petroleum Hydrocarbons, Chemical Oxygen Demand, Total Cyanide, Radium 226, Salinity, Field Temperature, Field pH, Field Electrical Conductivity, Field Dissolved Oxygen					

7.4.9 Summary of Local Surface Water Quality

Surface water monitoring locations for the Touquoy Mine Site are provided on Figure 7.4. Locations SW-1, SW-11, SW-12, and SW-23 are identified as 'background' as they are located upgradient from the Project facilities and are not expected to be affected by the Project activities. Locations SW-2, SW-3, SW-13, SW-15, SW-18, SW-19, SW-20, and SW-21 are grouped as 'downstream' sites as they are located adjacent to and/or downstream to the Touquoy Mine Site.

Sampling of surface water sites began in 2016 before mine construction and operation activities. Surface water samples taken before mine operations are considered representative of baseline conditions. Based on a review of the pre-development surface water quality results (Stantec 2018a), surface water at the monitoring stations upstream and downstream of the Touquoy Mine Site had elevated baseline concentrations of arsenic, aluminum, cadmium, copper, iron, lead, manganese, and zinc that exceeded NSECC Tier 1 EQS. In addition, cobalt, manganese, silver, and mercury exceeded the Canadian Council of Ministers of the Environment (CCME) guidelines for the protection of freshwater aquatic life (CCME 2021). These exceedances are considered to be naturally occurring, or the result of historical anthropogenic (i.e., non-Project related) activities, varying seasonally and representing baseline conditions at the Touquoy Mine Site. A remedial action plan was implemented by AMNS in 2018 that involved the delineation, removal, and management of two areas of historical tailings piles located in the vicinity of the around the Open Pit area, and the installation of additional groundwater monitoring wells to assess potential changes to groundwater quality (Stantec 2019a).

A summary of surface water exceedances of Industrial Approval (IA) Water Quality criteria during baseline (Table 7.12) and current approved operation (Table 7.13) is provided below. The IA Water Quality criteria are as provided in Appendix K of the IA, and are based on NSECC Tier 1 EQS and CCME guidelines for the protection of freshwater aquatic life. Exceedances of aluminum, arsenic, cadmium, and iron were reported at the majority of sampling locations. Exceedances of lead, manganese, mercury, silver, vanadium, and zinc were reported at individual monitoring stations for a select few events.

Table 7.12 Number Summary of Surface Water Quality Parameter Exceedances Prior to Mine Development (2016-2017)

Water Quality Parameter	SW-1²	SW-2	SW-3	SW-11²	SW-12²	SW-13	SW-15	SW-18	SW-19	SW-20	SW-21	SW-23²	No. of Stations with Exceedances (/12)
Total Aluminum (Al)	21	22	20	22	21	20	19	21	21	19	19	9	12
Total Arsenic (As)	20	18	14	22	0	2	9	11	8	2	0	3	10
Total Cadmium (Cd)	12	14	11	15	13	11	17	13	20	17	14	9	10
Total Cobalt (Co)	0	0	0	0	0	0	0	0	1	0	0	0	1
Total Copper (Cu)	0	0	3	1	0	0	6	0	3	2	0	0	5
Total Iron (Fe)	17	17	14	16	1	2	18	14	17	18	6	7	12
Total Lead (Pb)	0	0	5	0	0	1	12	0	2	4	2	0	6
Total Manganese (Mn)	0	0	1	0	0	0	1	0	2	0	0	0	3
Total Mercury (Hg)	0	0	0	0	0	1	3	0	0	1	0	0	3
Total Silver (Ag)*	0	0	0	0	0	0	0	0	1	0	0	0	1
Total Vanadium (V)	0	0	0	0	0	0	0	0	1	1	0	0	2
Total Zinc (Zn)	0	0	0	0	1	2	2	0	1	1	0	0	5
No. of Monitoring Events per Station	**21**	**22**	**20**	**22**	**21**	**20**	**19**	**21**	**21**	**19**	**19**	**19**	**-**

Note:

[1]WAD = Weak Acid Dissociable

[2]Site is representative of background conditions.

Remaining sites are representative of downstream conditions.

For existing conditions, aluminum, arsenic, cadmium, and iron were exceeded at the majority of stations. Selenium is elevated at SW-15. Exceedances of lead, manganese, mercury, zinc, and WAD cyanide were reported at individual monitoring stations for a select few events.

Table 7.13 Summary of Surface Water Quality Parameter Exceedances for Touquoy Mine Site (2018-2020)

Parameter	SW-1²	SW-2	SW-3	SW-11²	SW-12²	SW-13	SW-15	SW-18	SW-19	SW-20	SW-21	SW-23²	No. of Stations with Exceedances (/12)
Total Aluminum	36	35	30	36	35	31	23	31	34	26	31	3	12
Total Arsenic	28	22	16	30	0	0	33	14	3	13	0	4	9
Total Cadmium	16	15	12	16	15	12	11	13	24	11	11	0	11
Total Cobalt	0	0	0	0	0	0	21	0	0	1	0	0	2
Total Copper	0	1	0	0	1	1	3	1	2	0	0	1	12

Table 7.13 Summary of Surface Water Quality Parameter Exceedances for Touquoy Mine Site (2018-2020)

Parameter	SW-1[2]	SW-2	SW-3	SW-11[2]	SW-12[2]	SW-13	SW-15	SW-18	SW-19	SW-20	SW-21	SW-23[2]	No. of Stations with Exceedances (/12)
Total Iron	21	21	8	22	0	1	6	17	7	18	5	3	11
Total Lead	0	0	0	0	0	0	0	0	0	0	1	1	2
Total Manganese	0	0	0	0	0	0	1	0	2	0	0	0	2
Total Mercury	0	0	0	0	0	0	0	0	0	4	0	0	1
Total Nickel	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Selenium	0	0	0	0	0	0	14	0	0	0	1	0	2
Zinc	0	0	0	0	0	0	0	0	1	0	0	0	1
WAD Cyanide[1]	0	0	0	0	0	0	2	0	0	0	0	0	1
No. of Monitoring Events per Station	**36**	**36**	**35**	**36**	**36**	**31**	**34**	**31**	**36**	**26**	**34**	**34**	**-**

Note:
[1]WAD = Weak Acid Dissociable
[2]Site is representative of background conditions.
Remaining sites are representative of downstream conditions.

7.4.9.1 Moose River

Average metals concentrations at the downstream surface water site (SW-2) on Moose River are presented in Table 7.14. Although exceedances of IA Water Quality Criteria for total aluminum, arsenic, cadmium, and iron were noted, water quality in Moose River at SW-2 is consistent with the background water quality (SW-11 and SW-1). The water quality in Moose River does not appear to be affected by operation at the Touquoy Mine Site (Stantec 2021f; SD 19a).

Table 7.14 Surface Water Quality Seasonal Mean in Moose River (SW-2), Existing Conditions

Parameter	Units	IA Water Quality Criteria	Moose River (SW-2) Mean Concentration		
			2018	2019	2020
Sample Size	-	-	12	12	13
Total Aluminum	ug/L	5	**151**	**156**	**170**
Total Antimony	ug/L	20	<1	<1	<1
Total Arsenic	ug/L	5	**8.81**	**9.18**	**11.8**
Total Cadmium	ug/L	0.01	**0.0115**	**0.016**	**0.0133**
Total Calcium	ug/L	NA	963	1190	1,080
Total Chromium	ug/L	8.9	<1	<1	<1
Total Cobalt	ug/L	10	<0.4	<0.4	<0.4

Table 7.14 Surface Water Quality Seasonal Mean in Moose River (SW-2), Existing Conditions

Parameter	Units	IA Water Quality Criteria	Moose River (SW-2) Mean Concentration		
			2018	2019	2020
Total Copper	ug/L	2	0.507	<2	0.656
Total Iron	ug/L	300	**386**	**388**	**506**
Total Lead	ug/L	1	<0.5	<0.5	<0.5
Total Magnesium	ug/L	NA	438	543	463
Total Manganese	ug/L	820	49.9	65.3	55.1
Total Nickel	ug/L	25	<2	<2	<2
Total Phosphorous	ug/L	NA	<100	<100	<100
Total Potassium	ug/L	NA	194	188	142
Total Selenium	ug/L	1	<0.5	<1	<0.5
Total Silver	ug/L	0.1	<0.1	<0.1	<0.1
Total Sodium	ug/L	NA	2,610	3330	2,770
Total Uranium	ug/L	300	<0.1	<0.1	<0.1
Total Zinc	ug/L	30	<5	<5	<5
Dissolved Chloride	mg/L	250	4.53	6.18	6
Total Nitrate as N	mg/L	13	<0.05	<0.05	0.1
Dissolved Sulphate	mg/L	NA	<2	<2	2.5
Total Ammonia as N	mg/L	NA	0.0529	<0.05	0.069
Unionized Ammonia	mg/L	0.019	0.000352	9.26E-05	0.000227
WAD Cyanide	mg/L	0.005	<0.003	<0.003	<0.003
pH	-	-	6.05	6.01	5.83
Hardness	mg/L	-	5.28	4.37	4.61

Notes:
Bold indicates exceeds IA Water Quality Criteria
µg/L = micrograms per litre, mg/L = milligrams per litre
NA = No applicable guideline or standard
WAD = weak acid dissociable
Unionized ammonia calculated from total ammonia

Watercourse #4

Surface water quality results (seasonal mean) in Watercourse #4 (SW-3) were compared to IA Water Quality Criteria and presented in Table 7.15, below. Exceedances were reported for aluminum, arsenic, cadmium, and iron (2018 only). These exceedances are consistent with water quality at upstream background monitoring site SW-23 over the historic monitoring period (Stantec 2018a, 2019b, 2020c, 2021f). Increasing trends of sulphate have been observed at SW-19 (adjacent to WRSA) and downstream at SW-3 and were investigated with results appended to the annual surface water and groundwater monitoring report for 2020 (Stantec 2021f; SD 19a). The observed increase in sulphate is suspected to represent the discharge of seepage from the WRSA. The seepage is anticipated, and sulphate concentrations have been both predicted (Lorax 2020a, 2020b; Appendix D.4) and assessed in relation to Watercourse #4 (Minnow 2021; Appendix D.3). At an average sulphate concentration of 118.39 mg/L at SW-19 (associated hardness of 145.5 mg/L), average sulphate concentrations are below Health Canada drinking water aesthetic guideline and the British Colombia Sulphate Water Quality Guideline (MECCS 2021) which is the only quantitative sulphate guideline in Canada for the protection of freshwater aquatic life.

Table 7.15 Surface Water Quality Seasonal Mean in Watercourse #4 (SW-3), Existing Conditions

Parameter		IA Water Quality Criteria	Watercourse #4 (SW-3) Mean Concentration		
			2018	2019	2020
Sample Size	-	-	12	11	13
Total Aluminum	ug/L	5	**271**	**113**	**96.7**
Total Antimony	ug/L	20	<1	<1	<1
Total Arsenic	ug/L	5	**5.09**	**7.03**	**5.32**
Total Cadmium	ug/L	0.01	**0.0133**	**0.0192**	**0.0149**
Total Calcium	ug/L	NA	36,500	58,000	50,100
Total Chromium	ug/L	8.9	<1	1.6	<1
Total Cobalt	ug/L	10	0.905	0.703	<0.4
Total Copper	ug/L	2	<2	0.67	<0.5
Total Iron	ug/L	300	**363**	190	130
Total Lead	ug/L	1	<0.5	<0.5	<0.5
Total Magnesium	ug/L	NA	6,250	9,927	9410
Total Manganese	ug/L	820	109	118	130
Total Nickel	ug/L	25	<2	<2	<2
Total Phosphorous	ug/L	NA	<100	<100	<100
Total Potassium	ug/L	NA	2,080	2363	1,860
Total Selenium	ug/L	1	<1	<0.5	<0.5
Total Silver	ug/L	0.1	<0.1	<0.1	<0.1

Table 7.15 Surface Water Quality Seasonal Mean in Watercourse #4 (SW-3), Existing Conditions

Parameter		IA Water Quality Criteria	Watercourse #4 (SW-3) Mean Concentration		
			2018	2019	2020
Total Sodium	ug/L	NA	8,330	7,263	8,170
Total Uranium	ug/L	300	0.2	0.38	0.159
Total Zinc	ug/L	30	<5	<5	<5
Dissolved Chloride	mg/L	250	13.2	12.92	16
Total Nitrate as N	mg/L	13	0.681	0.53	0.5
Dissolved Sulphate	mg/L	NA	86.7	142.4	133
Total Ammonia as N	mg/L	NA	<0.05	<0.05	<0.05
Unionized Ammonia	mg/L	0.019	0.000108	0.000101	5.38E-05
WAD Cyanide	mg/L	0.005	<0.003	<0.003	<0.003
pH	-	-	7.07	7.23	6.61
Hardness	mg/L	-	119.83	189.00	171.00

Notes:
Bold indicates exceeds IA Water Quality Criteria
µg/L = micrograms per litre, mg/L = milligrams per litre
NA = No applicable guideline or standard
WAD = weak acid dissociable
Unionized ammonia calculated from total ammonia

Scraggy Lake

Surface water quality results (seasonal mean) at the outlet of Scraggy Lake (SW-13) are presented in Table 7.16. Scraggy Lake is downstream of the Touquoy Mine Site and is both a source of water for the site as well as the receiving body for treated effluent discharge from the TMF. Exceedances are typically reported for aluminum at SW-13. Increases of cobalt (SW-15 and SW-21) and arsenic (SW-20) from baseline concentrations are noted in historic monitoring reports but concentrations at these sites remain below guideline values. Nickel concentrations are noted to increase over time at SW-15 and selenium was reported to be elevated above guidelines values at this site (Stantec 2021f; SD 19a). Selenium is not reported above guideline values at the Scraggy Lake outlet site (SW-13).

Table 7.16 Surface Water Quality Seasonal Mean at Scraggy Lake Outlet (SW-13), Existing Condition

Parameter		IA Water Quality Criteria	Scraggy Lake (SW-13) Mean Concentration		
			2018	2019	2020
Sample Size	-	-	11	10	10
Total Aluminum	µg/L	5	**128**	**107.6**	**106**
Total Antimony	µg/L	20	<1	<1	<1

Table 7.16 Surface Water Quality Seasonal Mean at Scraggy Lake Outlet (SW-13), Existing Condition

Parameter		**IA Water Quality Criteria**	**Scraggy Lake (SW-13) Mean Concentration**		
			2018	**2019**	**2020**
Total Arsenic	µg/L	5	<1	<1	<1
Total Cadmium	µg/L	0.01	0.0125	0.0146	<0.01
Total Calcium	µg/L	NA	1,140	3,860	3,740
Total Chromium	µg/L	8.9	<1	<1	<1
Total Cobalt	µg/L	10	<0.4	1.939	0.808
Total Copper	µg/L	2	<2	<2	<0.5
Total Iron	µg/L	300	209	150	172
Total Lead	µg/L	1	<0.5	<0.5	<0.5
Total Magnesium	µg/L	NA	485	600	595
Total Manganese	µg/L	820	35.1	36.2	38.1
Total Nickel	µg/L	25	<2	<2	<2
Total Phosphorous	µg/L	NA	<100	<100	<100
Total Potassium	µg/L	NA	285	1358	1,200
Total Selenium	µg/L	1	<1	<0.5	<0.5
Total Silver	µg/L	0.1	<0.1	<0.1	<0.1
Total Sodium	µg/L	NA	3,050	6,960	6,220
Total Uranium	µg/L	300	<0.1	<0.1	<0.1
Total Zinc	µg/L	30	<5	<5	<5
Dissolved Chloride	mg/L	250	5.02	4.5	4
Total Nitrate as N	mg/L	13	<0.05	0.186	0.109
Dissolved Sulphate	mg/L	NA	2.84	20.63	20.1
Total Ammonia as N	mg/L	NA	<0.05	0.057	<0.05
Unionized Ammonia	mg/L	0.019	7.02E-06	1.42E-05	7.95E-06
WAD Cyanide	mg/L	0.005	<0.003	<0.003	<0.003
pH	-	-	5.91	6.54	6.01
Hardness	mg/L	-	4.95	12.60	12.40

Notes:
Bold indicates exceeds IA Water Quality Criteria
µg/L = micrograms per litre, mg/L = milligrams per litre
NA = No applicable guideline or standard
WAD = weak acid dissociable
Unionized ammonia calculated from total ammonia

Square Lake

Surface water quality results (seasonal mean) at the outflow of Square Lake (SW-12) are presented in Table 7.17. Square Lake is upstream of the Touquoy Mine Site and is considered representative of background concentrations. Square Lake is drained by the Fish River east of the TMF to Scraggy Lake. Exceedances are typically reported for aluminum and cadmium at SW-12.

Table 7.17 Surface Water Quality Seasonal Mean at Square Lake Outlet (SW-12), Existing Conditions

Parameter		IA Water Quality Criteria	Square Lake (SW-12) Mean Concentration		
			2018	2019	2020
Sample Size	-	-	12	12	13
Total Aluminum	µg/L	5	**129**	**123**	**123**
Total Antimony	µg/L	20	<1	<1	<1
Total Arsenic	µg/L	5	<1	<1	<1
Total Cadmium	µg/L	0.01	**0.0128**	**0.0137**	**0.0113**
Total Calcium	µg/L	NA	1010	1390	1,150
Total Chromium	µg/L	8.9	<1	<1	<1
Total Cobalt	µg/L	10	<0.4	<0.4	<0.4
Total Copper	µg/L	2	<2	0.525	<0.5
Total Iron	µg/L	300	208	202	198
Total Lead	µg/L	1	<0.5	<0.5	<0.5
Total Magnesium	µg/L	NA	463	545	461
Total Manganese	µg/L	820	42	50.3	44.5
Total Nickel	µg/L	25	<2	<2	<2
Total Phosphorous	µg/L	NA	<100	<100	<100
Total Potassium	µg/L	NA	215	249	202
Total Selenium	µg/L	1	<1	<0.5	<0.5
Total Silver	µg/L	0.1	<0.1	<0.1	<0.1
Total Sodium	µg/L	NA	2370	2190	2,060
Total Uranium	µg/L	300	<0.1	<0.1	<0.1
Total Zinc	µg/L	30	<5	<5	<5
Dissolved Chloride	mg/L	250	4.5	4.36	3.85
Total Nitrate as N	mg/L	13	<0.05	<0.05	<0.05
Dissolved Sulphate	mg/L	NA	<2	3.38	2.74
Total Ammonia as N	mg/L	NA	<0.05	<0.05	<0.05
Unionized Ammonia	mg/L	0.019	0.000264	0.000086	3.21E-05
WAD Cyanide	mg/L	0.005	<0.003	<0.003	<0.003

Table 7.17 Surface Water Quality Seasonal Mean at Square Lake Outlet (SW-12), Existing Conditions

Parameter		IA Water Quality Criteria	Square Lake (SW-12) Mean Concentration		
			2018	2019	2020
pH	-	-	5.99	6.05	5.82
Hardness	mg/L	-	4.58	5.94	4.87

Notes:
Bold indicates exceeds IA Water Quality Criteria
µg/L = micrograms per litre, mg/L = milligrams per litre
NA = No applicable guideline or standard
WAD = weak acid dissociable
Unionized ammonia calculated from total ammonia

Contaminants of Potential Concern

A comprehensive pre-development water quality monitoring program was undertaken prior to construction and operation of the Touquoy Mine Site. Results of this monitoring program have identified several Contaminants of Potential Concern (COPC) measured within surface water bodies surrounding the Site. Concentrations of aluminum, arsenic, cadmium, and iron have been found to be above Tier 1 EQS or CCME FAL guidelines in baseline samples (pre 2018 construction and operation activity). A summary of baseline (2016 – 2017) COPC concentrations are provided in Table 7.18, below, for Moose River, Watercourse #4, Scraggy Lake and Square Lake.

Table 7.18 Maximum and Average COPC Baseline Concentrations (2016 - 2017)

Watercourse and Monitoring Location	Parameter	Aluminum	Arsenic	Cadmium	Iron
CCME FAL (ug/L) Exceedances are **bolded**		100	5	-	300
NS Tier 1 EQS (ug/L) Exceedances are underlined		-	300	-	-
Moose River at SW-2	Max (ug/L)	**350**	**30**	0.04	**850**
	Date of Max	13-Oct-16	27-May-16	13-Oct-16	21-Sep-17
	Mean (ug/L)	**169.23**	**12.25**	0.019	**483.1**
	75th Percentile (ug/L)	**195**	**18.25**	0.02	**622.5**
Watercourse #4 at SW-3	Max (ug/L)	**2,500**	**38**	0.057	**2,100**
	Date of Max	13-Oct-16	8-Jun-17	13-Oct-16	13-Oct-16
	Mean (ug/L)	**499.7**	**11.14**	0.021	**711.1**
	75th Percentile (ug/L)	**520**	**13**	0.03	**777.5**

Table 7.18 Maximum and Average COPC Baseline Concentrations (2016 - 2017)

Watercourse and Monitoring Location	Parameter	Aluminum	Arsenic	Cadmium	Iron
Scraggy Lake at SW-13	Max (ug/L)	**310**	**170**	0.071	**1,800**
	Date of Max	15-Sep-16	15-Sep-16	19-Apr-16	15-Sep-16
	Mean (ug/L)	**142.1**	**89.8**	0.022	297
	75th Percentile (ug/L)	**160**	<1.0	0.02	250
Square Lake at SW-12	Max (ug/L)	**260**	<1.0	0.021	**320**
	Date of Max	11-Jan-17	n/a	3-Apr-17	13-Oct-16
	Mean (ug/L)	**122.86**	<1.0	0.01	229
	75th Percentile (ug/L)	**145**	<1.0	0.02	270

7.5 PROJECT INTERACTIONS WITH SURFACE WATER RESOURCES

Project activities that might interact with surface water resources for each potential effect are identified in Table 7.19

Table 7.19 Project Interactions with Surface Water Resources

Project Activities	Change in Surface Water Quantity	Change in Surface Water Quality
In-Pit Tailings Disposal		
Deposition of Tailings	X	X
Water Management	X	X
Reclamation and Decommissioning	X	X
Waste Rock Storage Area Expansion		
Site Preparation	X	X
Operation of the WRSA	X	X
Water Management (e.g., modification of water drainage structures; relocation of monitoring well)	X	X
Reclamation and Decommissioning	X	X
Clay Borrow Area		
Site Preparation	X	X
Operation of Clay Borrow Area	X	X
Water Management	X	X
Reclamation and Decommissioning	X	X

Table 7.19 Project Interactions with Surface Water Resources

Project Activities	Change in Surface Water Quantity	Change in Surface Water Quality
New Plant Access Road		
Site Preparation	X	X
Operation of Road for Site Traffic	X	X
Reclamation and Decommissioning	X	X

All Project activities have the potential to affect surface water quantity and quality.

7.5.1 In-pit Tailings Disposal

In-pit tailings disposal will potentially interact with surface water resources through alterations of water quality and quantity associated with the deposition of tailings, related associated water management activities, and reclamation and decommissioning activities. Currently the Open Pit is actively dewatered during operation with water from the Open Pit pumped to the TMF. To create the required subaqueous conditions for tailings disposal, the dewatering operation will cease, and flow normally discharged to Scraggy Lake (via the ETP) will be diverted to the Open Pit to supplement the natural inflow of groundwater and surface water and precipitation into the Open Pit. As currently the TMF receives Open Pit dewater and WRSA runoff, when tailings deposition transitions to the Open Pit, site runoff and seepage collection water will be diverted to the Open Pit. This approach is expected to create a new closed loop between the Open Pit and Mill Facility, and the TMF will become a “near zero-discharge” facility for the period of Touquoy tailings in-pit deposition. Discharge from the TMF is not anticipated, but could occur under extreme climate events. As the Open Pit starts to fill with tailings and water, the groundwater flow gradients to the Open Pit will lessen and eventually reverse, at which time water in the Open Pit will seep towards the Moose River. When the Open Pit infilling is complete, surface flow will be directed to Moose River via a constructed spillway or discharge structure.

7.5.2 WRSA Expansion

Expansion of the WRSA by 6.3 ha will increase the area of the WRSA from 22.4 ha to 28.7 ha and will alter the topography and cover of the drainage areas associated with Watercourse #4 and Fish River headwaters, reducing surface water quantity normally draining to these watercourses. Of the 6.3 ha area of WRSA expansion, 5.1 ha is in the Watercourse #4 catchment and 1.2 ha is in the Scraggy Lake catchment (reporting specifically to Square Lake which drains via the Fish River to Scraggy Lake). Runoff associated with the WRSA is considered to be mine-contact water and has the potential to contain increased TSS, nutrients and possible contaminants of potential concern.

7.5.3 Clay Borrow Area

Expansion of the Clay Borrow Area will increase the existing site from approximately 7.6 ha to 13.5 ha and will alter the topography and vegetative cover of the drainage area associated with Watercourse #4, potentially resulting in a reduction of surface water quantity to the watercourse. All of the Clay Borrow Area expansion is within the boundaries of Watercourse #4. Runoff generated over the exposed clay has the potential to contain elevated TSS, aluminum and other parameters associated with clay soil and could affect the water quality of Watercourse #4.

7.5.4 Relocation of Plant Access Road

Construction and operation of the Plant Access Road is required for the WRSA expansion and has the potential to affect surface water quantity through changes in topography and vegetative cover. Changes to surface water quality are possible through erosion and sedimentation, as well as dust emissions during construction, operation, and decommissioning activities. The new Plant Access Road area is 4.1 ha and is within the Moose River watershed area.

Accidental releases of hazardous substances which could occur in association with the assessed Project components can also affect surface water resources; these are assessed in Accidents and Malfunctions (Section 11.0).

7.6 MITIGATION

The following mitigation measures will be implemented to reduce or eliminate adverse effects on surface water resources:

- Engineered facilities complying with physical stability requirements will be constructed to store waste rock.
- A Surface Water Management Plan (Stantec 2017) has been developed as a requirement of the current IA and will be updated to reflect the proposed modifications to the Approved Project. Engineered water management systems will be constructed to collect runoff and seepage from the WRSA, Clay Borrow Area, and Plant Access Road during the operational phase and closure phases.
- Contact water (effluent) that is composed of inflows and runoff from the Open Pit walls, runoff, and seepage from the WRSA, and runoff and seepage from the TMF will be collected and treated, if determined to be required, prior to discharge to the environment during the operation and post-closure phases. During the closure and the early years of post-closure, the majority of contact water that is collected on site will gravity drain or be pumped to the Open Pit to accelerate pit filling. Grouting of Open Pit fractures to reduce exfiltration from the pit will be considered during detailed design if water quality trends indicate it is required.

- During in-pit tailings disposal, the Open Pit will become the source of process reclaim water with runoff and collected seepage from other mine areas (i.e., Mill Facility, Clay Borrow Area, WRSA, TMF proposed to be diverted to the Open Pit to offset consumptive water demand (i.e. deposited tailings porewater sequestration). This change will create a new closed loop for Mill Facility reclaim with the Open Pit and discontinue the existing closed loop for reclaim supply from the TMF.
- Processing consumptive demand can be offset by excess water collected at the TMF, WRSA, Clay Borrow Area, and Mill Facility under climate normal runoff and seepage conditions. Additionally, Open Pit pre-filling and start up water can be supplied by advanced diversion of treated ETP effluent to the pit prior to tailings deposition as well as drawdown of water volume in the TMF and polishing ponds at startup prior to reclaiming from the Open Pit. When the above pre-filling, start up and excess water collection are considered together, Mill Facility reclaim can be satisfied from the Open Pit for the Project operations period even under 25-year dry climate conditions. Further, this approach will create a water cover over the tailings from the onset of in pit deposition which will limit the potential for tailings oxidation.
- The drawdown of ponded water in the TMF and polishing ponds and the pumping of ongoing runoff and seepage to the Open Pit will create a "near-zero discharge" environment from the TMF. During in-pit tailings deposition, excess water from the TMF will be pumped to the Open Pit. Further, for an estimated 9 years after commencement of in-pit tailings deposition, a portion of excess TMF water will continue to be pumped to the Open Pit to accelerate pit fill and create a deep-water cover over the deposited tails. Acceleration of pit filling reduces the exposure time of pit walls to air and shortens the timeline between end of the operation and pit lake overflow, providing a greater certainty regarding effluent water quality. Transitioning the TMF to "near-zero discharge" will eliminate the 1.5 M m^3/y (average) effluent discharge to Scraggy Lake, provide significant water quality contingency to proceed with TMF closure activities and allow TMF closure to complete covering and vegetation establishment before excess runoff and seepage are released to the Scraggy Lake environment in post-closure.
- To avoid further Project effects to flows in Watercourse #4, a new WRSA sediment pond and treatment system designed for nitrate removal will be constructed at the water return location in Watercourse #4 to provide treatment for the portion of WRSA runoff returned to the watercourse. A FDP will be established in Watercourse #4 to provide a control point for sampling of returned flow in accordance with MDMER regulation. The water quantity design goals of the new WRSA sedimentation pond will be to replace anticipated flow losses to Watercourse #4 from the WRSA and Clay Borrow Area and to do so through hydrograph matching such that future instantaneous flows are maintained within 10% of existing flows.
- While the Project will not completely eliminate effluent discharge, it will for the operation and pit-filling period considerably reduce the volume of effluent discharge to the environment. Effluent from the new WRSA sediment pond and treatment system supplementing flow in Watercourse #4 will meet MDMER effluent limits and aquatic toxicity requirements prior to being discharged to the environment.
- The limits for approved clearing, grubbing and topsoil overburden removal will be clearly identified (flagging/survey stakes) in the field prior to the commencement of any work.

- Work operation will be conducted in a manner to protect watercourses and wetlands from siltation and disturbance.
- The existing Erosion and Sediment Control Plan (Stantec 2010, 2020b) for the Touquoy Mine Site will be updated to show the new proposed site layout and subsequent changes to erosion and sediment controls. The Erosion and Sediment Control Plan, which will be implemented during the construction, operation, and closure phases, will include best management practices to limit erosion, promote settling of sediments, and mitigate the mobilization and migration of suspended solids into nearby surface water features. Best management practices for erosion and sediment control may include: the use of earthwork methods to reduce the area of exposed ground, slope length and grade, ditching, sediment ponds/traps, channel, and slope armouring, use of natural vegetation buffers, re-vegetation of disturbed soil, and runoff controls (i.e., sediment fencing, coir logs and small check dams). Sediment control measures will be installed prior to construction and maintained until potentially erodible material is stabilized.
- Areas to be cleared will have sediment and erosion control measures implemented prior to the initiation of clearing activities. The sediment and erosion control measures will be adapted to suit the field conditions associated with the specific construction activities as construction proceeds.
- Work will be performed so that materials such as sediment, fuel or other hazardous materials do not enter watercourses and waterbodies through the implementation of sediment control measures and hazardous materials management practices. In the event of a release to the environment, the incident will be reported immediately to the appropriate regulatory authorities in accordance with the NSECC and the Emergency Response Plan, and Spill Contingency Plan and EPP will be implemented (Section 11.0).

7.7 ASSESSMENT OF RESIDUAL EFFECTS

7.7.1 Surface Water Quantity

Case studies presented by Richter et al. (2011) indicate that a high level of ecological protection is provided when flow alterations are within 10% of the natural flow. This is consistent with guidance provided by Fisheries and Oceans Canada (DFO 2013). Accordingly, a 10% change in flow is used as an initial screening in the assessment of changes in water quantity to determine if further analysis is required.

Waste Rock Storage Area Expansion

The expansion of the WRSA is expected to increase the area of the existing WRSA by approximately 6.3 ha, affecting existing watershed areas, and associated surface water quantity. Of the 6.3 ha expansion, 1.2 ha is located within the catchment 4 area draining the Fish River headwaters of Square Lake and. 5.1 ha is located within the catchment 1 area of Watercourse #4 (Figure 7.4). The area reduction in catchment 4 represents 0.37% of the catchment 4 area and 0.22% of the overall Fish River headwaters catchment area. The WRSA expansion results in negligible area diversion and no other proposed Project activities are predicted to affect the Fish River headwaters catchment area. Therefore, the surface water quantity in Square Lake and the Fish River headwaters will not be affected as a result of Project activities.

The WRSA expansion is predicted to affect 8.3% of the total area of catchment 1 and 2.8% of the overall area draining to Watercourse #4. Without avoidance or mitigation, the reduction in contributing watershed area in catchment 1 upstream of Mooseland Road would result in a reduction of mean annual flow (MAF) to Watercourse #4 of 1.51 L/s from 17.49 L/s and MMF reductions as indicated in Table 7.20, below.

Table 7.20 Changes in Mean Monthly Flow to Catchment 1, Watercourse #4

Month	Watercourse #4 - Catchment 1 – Upstream of Mooseland Road		
	Existing (L/s)	Modified (L/s)	Difference (L/s)
January	18.60	16.99	1.61
February	16.95	15.48	1.47
March	25.23	23.05	2.18
April	33.82	30.90	2.92
May	19.61	17.91	1.70
June	10.35	9.46	0.90
July	6.13	5.60	0.53
August	5.75	5.25	0.50
September	7.00	6.39	0.60
October	14.54	13.28	1.26
November	25.92	23.68	2.24
December	26.00	23.75	2.25
MAF	17.49	15.98	1.51
Catchment area (km^2)	0.61 km^2	0.56 km^2	0.05 km^2

Runoff from the western area of the WRSA is currently collected via perimeter ditching and diverted to a western storage pond before being pumped to the TMF. With the proposed expansion of the WRSA, approximately 21 ha of the western area of the WRSA (16 ha of existing and 5 ha of the expanded WRSA area) will be diverted to a newly constructed treatment system for sediment and nitrate removal before being gravity drained to Watercourse #4 in the headwater area upstream of Mooseland Road.

Flow returned to Watercourse #4 via the newly constructed WRSA sedimentation pond and treatment system is intended to mitigate both the WRSA expansion (5.1 ha) and the Clay Borrow Area expansion (7.8 ha). A total of 12.9 ha would be affected from the Watercourse #4 drainage area as a result of these proposed modifications. As runoff coefficients change between the existing and modified scenario, a WRSA area of approximately 20.5 ha is required to make up the anticipated instantaneous to annual flow volume loss resulting from proposed expansion of the WRSA and Clay Borrow Area. A volume-balance for the existing and proposed modified conditions is provided in Table 7.21, below. Volumes are calculated using the climate normal annual precipitation depth of 1,400 mm per the Halifax Stanfield

International Airport Climate Station (Station ID: 8202251) (ECCC 2021). Runoff coefficients have been empirically refined for the site using flow data collected during mine operation. Diversion of 12.9 ha from the Watercourse #4 drainage area would result in an annual loss of approximately 12,100 m^3. Returning flow from a 20.5 ha section of the WRSA drainage area would return approximately 12,198 m^3 to the watercourse on an annual basis, thus achieving no net change in surface water quantity to Watercourse #4.

Table 7.21 Area Requirements for Flow Return to Watercourse #4

Parameters	Existing	Modified	Annual Runoff (m^3)
Runoff Coefficient	0.67	0.43	12,100
Drainage Area (ha)	12.9	20.5	12,198

Using the areas and runoff coefficients shown in Table 7.21, above, a summary of monthly flow volumes is provided in Table 7.22, below. The return of an additional 20.5 ha of WRSA area to Watercourse #4 during proposed Project modifications provides monthly runoff values to the watercourse within ±100 m^3 of existing conditions.

Table 7.22 Monthly Flow to Watercourse #4, Existing and Modified Conditions

Month	Precipitation (mm)	Monthly Runoff (m^3)	
		Existing	Modified
January	134.3	11,608	11,701
February	105.8	9,144	9,218
March	120.1	10,380	10,464
April	114.5	9,896	9,976
May	111.9	9,672	9,749
June	96.2	8,315	8,381
July	95.5	8,254	8,320
August	93.5	8,081	8,146
September	102	8,816	8,887
October	124.9	10,795	10,882
November	154.2	13,328	13,435
December	143.3	12,385	12,485

The operational goals of the new sedimentation pond for the WRSA would be to collect runoff and seepage suspended solids would be settled out of the runoff. The runoff would then be drained by gravity to a location on Watercourse #4 as upstream of Mooseland Road as possible. The pond would be designed as a wet pond with permanent pool and active flood storage for larger storm and melt events. In wet ponds, the primary water quality factor is the water residence time between runoff events as well as the design pond drawdown period. Thus, while the pond may have a design sedimentation drawdown period of 24 hours to provide capture of particle > 5 microns and 80% TSS removal, the inter-event residence time of the more permanent pool substantially increases that sedimentation residence time factor. Importantly from a water quality perspective, when a new runoff or melt event flows into the pond, it begins an outlet flow event of water from the permanent pool. As a result, the sediment pond discharge will match the runoff/melt event hydrograph, while reducing the peak to reduce erosion potential.

Clay Borrow Area

The existing Clay Borrow Area covers approximately 7.6 ha and the proposed expansion will increase the development area to approximately 15.6 ha (including pond area at the overburden stockpile).

Perimeter ditching will be constructed to collect runoff from the expanded area and this flow will be diverted to the Open Pit when in-pit tailings disposal begins. Flow from the expanded area would naturally drain to the headwaters of catchment areas 2 and 3 for Watercourse #4, and the modified condition represents a respective reduction in catchment area of 8.2% and 5.6%. As described above, this flow is being returned to Watercourse #4 at the mid-point of catchment area 1 from the proposed WRSA sediment pond. Table 7.23 presents the predicted changes in MMF to catchment areas 2 and 3 for Watercourse #4.

Table 7.23 Changes in Mean Monthly Flow to Catchments 2 and 3, Watercourse #4

Month	Watercourse #4 - Catchment 2 - SW-3			Watercourse #4 - Catchment 3 – Otter Dam		
	Existing (L/s)	Modified (L/s)	Difference (L/s)	Existing (L/s)	Modified (L/s)	Difference (L/s)
January	12.99	11.92	1.06	23.27	21.97	1.30
February	11.83	10.87	0.97	21.21	20.02	1.19
March	17.61	16.17	1.44	31.56	29.79	1.77
April	23.61	21.68	1.93	42.32	39.94	2.37
May	13.69	12.57	1.12	24.53	23.16	1.38
June	7.23	6.64	0.59	12.95	12.23	0.73
July	4.28	3.93	0.35	7.67	7.24	0.43
August	4.01	3.68	0.33	7.19	6.79	0.40
September	4.88	4.48	0.40	8.75	8.26	0.49
October	10.15	9.32	0.83	18.19	17.17	1.02
November	18.10	16.62	1.48	32.43	30.61	1.82
December	18.15	16.67	1.48	32.53	30.71	1.82
MAF	12.21	11.21	1.00	21.88	20.66	1.23
Catchment area (km^2)	0.43 km^2	0.39 km^2	0.04 km^2	0.77 km^2	0.72 km^2	0.04 km^2

Relocation of Plant Access Road

Construction of the new Plant Access Road is expected to divert approximately 4.1 ha from the Moose River drainage area which represents less than 0.1% of the 4,865 ha drainage area to Moose River. This proposed modification would therefore result in a negligible effect on surface water quantity.

In-pit Tailings Disposal

Upon commencement of in-pit tailings disposal, tailings and site water currently pumped to the TMF will be diverted to the Open Pit to supplement process water supply during operation and accelerate pit filling during reclamation. The low-grade ore will be processed during operation at a nominal rate of 8,900 tpd. An Open Pit water balance was completed to quantify inflows to the Open Pit during disposal and post-closure. The water balance was run based on climate normal conditions. A flow summary is given in Table 7.24, below.

Table 7.24 Open Pit Water Balance for Project and Closure Conditions

Project Activity	**Water Flow from Project Activity (m^3/day)**		
	Mine Process Water During Operation		
Scraggy Lake Withdrawal used in Processing	420		
Moisture Content of Ore Going into Mill Facility	222		
Water Lost to Evaporation and Process Loses Spillage at Mill Facility	-384		
Water Discharged in Tailings Slurry	-12,807		
Total Reclaim to Mill Facility	12,585		
Water Retained in Consolidated Tailings (i.e. Porewater Lockup)	-3,718		
Net Water Demand Deficit	**-3,496**		
	Other Minewater Sources		
Open Pit Water Balance	**Average During Operation**	**Average During Reclamation (Pit Water Filling)**	**Average During Post Closure (Pit Full)**
Groundwater Inflow to Open Pit	789	623	410
Net Direct Precipitation/runoff to Pit Catchment	1,818	1,639	1,438
WRSA Runoff to Open Pit	258	329	402
Pumped from Scraggy Stockpile to Open Pit	353	352	353
Polishing Pond Flow to Open Pit	254	0	0
TMF Runoff to Mill Facility	2,490	0	0
Total non-process Flow to Open Pit	5,964	2,942	2,604
Site Discharge	During Operation	During Reclamation	During Closure
ETP Discharge to Scraggy Lake	0	2,090	2,130

Table 7.24 Open Pit Water Balance for Project and Closure Conditions

Project Activity	Water Flow from Project Activity (m^3/day)		
	Mine Process Water During Operation		
WRSA to Watercourse #4	258	329	402
Overflow from Open Pit to Moose River	0	0	2,194
Total Flow from Touquoy Mine Site	258	2,419	4,726

Note: Includes drainage from Plant Access Road Modification and Clay Borrow Area Modification

The existing ETP operates intermittently at a discharge of approximately 400 m^3/h during plant operation, per Section 7.4.5. Flow from the ETP to Scraggy Lake will cease as this flow is diverted to the Open Pit to supplement process water supply in operation. After operation, flow will be returned to Scraggy Lake from the rehabilitated TMF and WRSA. Flow return is contingent on closure design and will begin during the period when the Open Pit is filling with water and extend to post-closure.

A summary of flow to Scraggy Lake during the existing, Project, and project closure phases is given in Table 7.25. Flow from the Scraggy Lake watershed in the baseline condition is based on a 40.35 km^2 drainage area. Scraggy Lake withdrawal is currently 680 m^3/day, based on established rates for the project. Flow in excess of the current 680 m^3/day may be taken from Scraggy Lake to meet process water demands; however, total lake withdrawal is expected to be at or below the active permitted rate of 720 m^3/day.

Table 7.25 Summary of Estimated Annual Flow to Scraggy Lake

Estimated Annual Flow to Scraggy Lake (m^3/year)		
Pre-Development	38,000,760	
Existing Condition	38,262,426	
Changes to Scraggy Lake Flow (m^3/year)	**Existing**	**Project**
Flow from Diverted Drainage Areas	-1,048,684	-1,059,940
Scraggy Lake Withdrawal	-248,200	-262,800
ETP Discharge	1,558,550	0
Net Total	261,666	-1,322,740

Under existing operation, there is an increase in annual flow to Scraggy Lake of approximately 260,000m^3 per year to effluent discharge to Scraggy Lake. Additional flow is sourced from Open Pit dewatering and catchment area diversion from Watercourse #4 and is discharged to Scraggy Lake via the ETP. With the proposed commencement of in-pit tailings disposal, flow discharge will be diverted to the Open Pit, reducing use of the effluent FDP and there will be a reduction in total annual flow to Scraggy Lake of approximately -2.8%, or 1,060,000 m^3. This reduction is attributed the portion of Scraggy Lake drainage area that will continue to be diverted to the Open Pit until remediation of the TMF and WRSA. It is expected that the continued diversion of drainage area from Scraggy Lake will result in a moderate lowering of the normal lake level by 16 cm. This scenario will be mitigated with the return of diverted drainage area within the TMF and WRSA after operation.

The Open Pit is expected to reach ultimate capacity and overflow in Year 9 (after the commencement of in-pit tailings disposal) based on the elevation of the spillway overflow (108 m elevation) to Moose River. Once the Open Pit has reached capacity, discharge from the Open Pit to Moose River will become active. Flow will be conveyed to Moose River via an engineered spillway provided water quality is acceptable for direct discharge. An estimate of average monthly effluent flows to Moose River from the Open Pit spillway is provided in Figure 7.7, below. Spillway discharge represents less than 4% of the MMF in Moose River during the high flow month of April and approximately 1% of the MMF during the low flow month of July.

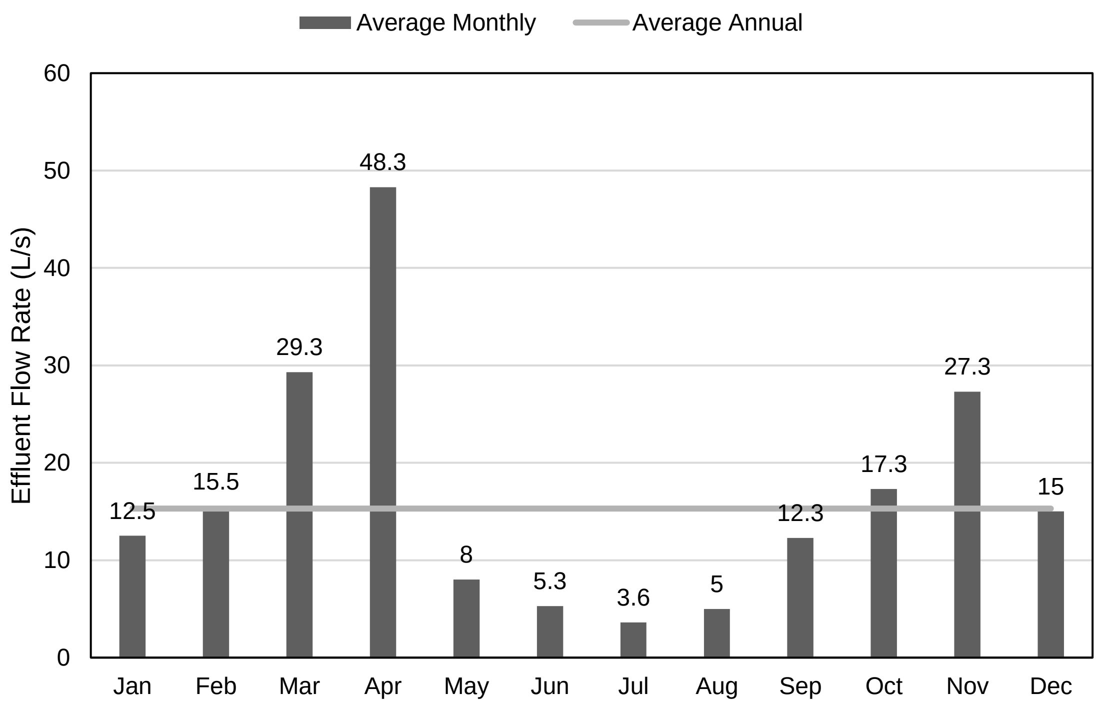


Figure 7.7 Modelled Mean Monthly Effluent Flow (L/s) to Moose River from the Open Pit Spillway

Summary

The installation of water management features to return surface water flow, as described above, to compensate for a potential loss in catchment area associated with the WRSA and Clay Borrow Area modifications will result in negligible changes to water flow in Watercourse #4. As described above, there will be negligible interaction between the proposed Plant Access Road and surface water quantity. Based on this, the residual effect of a change in surface water quantity as a result of these Project components are predicted to be negligible. Residual effects associated with the in-pit tailings disposal will result in a low magnitude change in surface water quantity to Scraggy Lake during the operational phase but will be reversed after the operation when runoff is returned from previously diverted drainage areas, and excess water is no longer required to augment process water demand. This effect will be temporary as changes in surface water flows to Scraggy Lake will be restored during the mine closure and post-closure phase.

With mitigation and environmental protection measures, the residual effect of a change in surface water quantity is predicted to be not significant as net changes in quantity are less than 10% and residual effects will not affect the support of existing ecological function.

7.7.2 Surface Water Quality

Waste Rock Storage Area Expansion

Flow from the existing and expanded WRSA will be returned to Watercourse #4 at a location upstream of Mooseland Road, as described in Section 7.7.1. A water quality model was prepared to simulate the overall water quality of WRSA runoff during operation, prior to capping the WRSA with a vegetated cover, and within Watercourse #4 during the operation, closure, and post-closure scenarios.

GoldSim (ver 12.1.4) was used to develop a numerical water quality model using a mass-balance approach which predicted end-point concentrations in Watercourse #4 at a location 2.5 km downstream of the WRSA pond outflow and in relation to input flows and concentrations. Two model scenarios were run: scenario 1, representing existing conditions (base-case) from 2018 to 2020; and scenario 2, a predicted future operation scenario (2021 to 2023) assuming the expanded WRSA. Models were prepared by Minnow Environmental Inc. (Minnow 2021; Appendix D.3) using water quality source terms previously developed by Lorax (2020a, 2020b; Appendix D.4) for each scenario and average and potential worst-case concentrations were provided. Model results were verified using historical surface water quality data from SW-3, a surface water sampling location on Watercourse #4. Under current conditions, sources of flow to Watercourse #4 related to the Approved Project are TMF seepage and WRSA seepage. The proposed modifications to the WRSA includes construction of a new sediment pond and small-scale mechanical treatment system designed for nitrate removal. A 60% nitrate removal rate was selected as a conservative estimate of future treatment system removal capacity. Pond design and selection and design of the treatment system will be completed during detailed design. In modelling water quality changes during Project conditions, discharge from this proposed system to Watercourse #4 was also taken into account.

Geochemical source terms were derived for WRSA runoff as provided by Lorax (2020a; Appendix D.4). Table 7.26, below, provides predictions of water quality in the proposed WRSA pond (i.e., water quality at the final discharge point) as compared to applicable MDMER thresholds. It is expected that flow returned to Watercourse #4 from the WRSA will be substantially lower than MDMER thresholds.

Table 7.26 Predicted WRSA Effluent Chemistry (Minnow 2021; Appendix D.3)

Parameters (µg/L)	MDMER Sched. 4 Table 2 (Existing Mine) MAMMC	WRSA Effluent Chemistry[1]		
		Existing Case Conditions (Scenario 1)	Project (Modified WRSA) Conditions (Scenario 2)	
		Average	Average	Worst-Case Scenario
Unionized Ammonia – N[2]	500	0.80	0.80	1.41
Total Cyanide (CN_T)	500	-	-	-
Arsenic (As)	300	27	32	60
Copper (Cu)	300	1.6	2.1	2.8
Lead (Pb)	100	0.25	0.25	0.5
Nickel (Ni)	500	12	15	48
Zinc (Zn)	500	4.2	5.2	5.4

Notes:
[1] Effluent chemistry data based on geochemical source terms developed by Lorax (2020a; Appendix D.4).
[2]Assuming a pH of 7.0 and temperature of 10°C
MAMMC= Maximum Authorized Monthly Mean Concentration

Model results are summarized by Minnow Environmental (2021) and provided in Appendix D.3. Several major ions are expected to increase under Project conditions (proposed WRSA expansion), where metals concentrations remain relatively close to existing case concentrations. Predicted concentrations are generally less than guideline values for the site noted below. The MDMER are met for all applicable parameters for average and worst-case predicted concentrations. The IA Water Quality Criteria concentrations are met with noted exceptions.

Aluminum and arsenic exceed CCME FAL and NSECC Tier 1 EQS and cadmium exceeds NSECC Tier 1 EQS in Watercourse #4 during Project conditions (WRSA expansion); however, exceedances have been reported for these parameters at SW-3 during baseline sampling and under current operating conditions.

Arsenic concentrations in Watercourse #4 are predicted to range from 7.8 to 16.3 µg/L with an average predicted concentration of 9.9 µg/L. The highest measured baseline concentration of arsenic at SW-3 is 38.0 ug/L sampled in June 2017 (Stantec 2018a).

Aluminum concentrations are predicted to range from 103 to 112 µg/L, which are below the average background concentration of aluminum of 425 µg/L in Watercourse #4. Baseline aluminum concentrations have reached 2,500 µ/gL as measured at SW-3 in October 2016 (Stantec 2018a).

Cadmium concentrations are predicted to range from 0.0127 to 0.0199 µg/L during Project conditions. The average baseline concentration of cadmium in Watercourse #4 is 0.0135 µg/L, although baseline concentrations as high as 0.057 µg/L were measured at SW-3 in October 2016 (Stantec 2018a).

After flow is returned to Watercourse #4 from the WRSA, nitrate and nitrite concentrations are predicted to increase in the watercourse for a period of time. A vegetated cover will be established on the WRSA to limit surface runoff contact with waste rock. Once the vegetated cover is established, contact toe seepage from the WRSA berm will be the remaining source of nutrients from this location. Nitrate concentrations are compared against a CCME FAL guideline value of 2,935 µg/L. Using a conservative removal rate of 60% via a WRSA treatment system, nitrate concentrations are predicted to be below the guideline value for both the average and worst-case conditions. Average concentration predictions of 1,083 ug/L nitrate are considered the likely scenario in Watercourse #4. Nitrite concentrations are compared against a CCME FAL guideline value of 60 µg/L. Predicted nitrite concentrations in Watercourse #4 are expected to be below this guideline value for both the average and worst-case conditions.

The above water quality predictions are for WRSA runoff and seepage conservatively do not account for the water quality improvement effects anticipated for parameters other than nitrate. For instance, aluminum in particulate form is expected to be settled out in the sedimentation pond. Arsenic which in the anoxic groundwater seepage environment is reduced will adsorb to precipitating ferric-oxihydroxide when it enters the oxidized surface water collection and drainage environment (Bisone et al. 2016) and settle out in the sedimentation pond. Similarly, cadmium concentrations are expected to improve through in-pond processes such as sedimentation and adsorption, and ion exchange. Pond design will be advanced in the detailed design phase prior to submission of regulatory approval application in consultation with NSECC and other regulatory stakeholders.

In summary, while there are some regulatory exceedances conservatively predicted for surface water quality as a result of the WRSA expansion, these exceedances are consistent with baseline (pre-development) and current Approved Project conditions and do not represent a change in surface water quality. A change in surface water quality with respect to nitrate and nitrite concentrations is expected as a result of Project activities. Nitrite is predicted and expected to remain below CCME FAL guideline values. With the installation of a treatment system to reduce nitrate concentrations at the location of WRSA pond discharge, nitrate concentrations in Watercourse #4 are expected to be below CCME FAL at the discharge point of Watercourse #4 to Otter Dam Flowage.

New Plant Access Road

The new Plant Access Road is located within the Moose River drainage area, with surface flow normally draining to the river. During construction, erosion and sediment control measures will be implemented as per the site-specific Erosion Prevention and Sediment Control Plan to reduce soil erosion and prevent sediment from reaching Moose River. A berm and ditching system will be installed along the road to collect and convey runoff to a clay-lined containment pond located at the low point along the road. The pond will be fitted with pumping infrastructure to convey storm water to the TMF prior to the commencement of in-pit tailings disposal. Once in-pit tailings disposal begins, road runoff will be diverted to the Open Pit With the implementation of mitigation, including installation of water management features, the construction, operation and decommissioning of the new Plant Access Road is not predicted to result in a change in surface water quality.

Clay Borrow Area

The expanded Clay Borrow Area is located within catchments 2 and 3 of the Watercourse #4 drainage area, with surface flow currently draining to Watercourse #4. During construction, erosion and sediment control measures will be implemented as per the site-specific Erosion Prevention and Sediment Control Plan to reduce soil erosion and prevent sediment from reaching the watercourse. Diversion berms and perimeter ditching will be constructed to direct runoff from the expanded area to a newly constructed sediment pond. The pond will be fitted with pumping infrastructure to convey storm water to the TMF prior to the commencement of in-pit tailings disposal. Once in-pit tailings disposal begins, Clay Borrow Area runoff will be diverted to the Open Pit. With the implementation of mitigation, including installation of water management features, the construction, operation and decommissioning of the Clay Borrow Area is not predicted to result in a change in surface water quality.

In-pit Tailings Disposal

During the operation phase, while the exhausted Open Pit is being used for tailings disposal, there is no predicted interaction with surface water resources (i.e., near-zero discharge). Once the Open Pit is nearing volumetric capacity (i.e., pit lake elevation of 108 m), during closure in Year 9 after initiating in-pit disposal, discharge from the pit lake to Moose River will be required. Direct discharge will occur through an engineered spillway at SW-2 on Moose River, provided the water quality is suitable for direct discharge. Water quality modelling was conducted to predict the pit lake water quality as the Open Pit fills following the in-pit disposal of tailings (Stantec 2021a; Appendix A.1). Geochemical source terms for the tailings pore water, inflows from the pit walls and floor, and effluent from the polishing pond and WRSA as provided by Lorax (2020a, 2020b; Appendix D.4) were multiplied by the associated flow rates and mixed in the Open Pit to predict water quality in the pit lake. The water from the pit lake was assumed to discharge to Moose River, and the blended water quality downstream of the spillway was assessed, based on the assimilative capacity of Moose River to receive the water quality from the pit lake (Stantec 2021d; Appendix D.5).

The assimilative capacity of Moose River was assessed using a CORMIX mixing zone model (Doneker & Jirka 2017). The model predicted the downstream distance from the Open Pit spillway in Moose River to where full mixing is achieved. Full mixing of discharge effluent in Moose River is achieved 120 m downstream of the discharge point, and water quality was predicted for 100 m and 120 m downstream. (Stantec 2021d; Appendix D.5). The water quality in Moose River more than 120 m downstream will have similar or improved water quality to that presented in Table 7.27.

Using the maximum monthly effluent flow rate of 48.3 L/s forecast to occur in April, dilution ratios in Moose River at 100 m and 120 m downstream of the spillway discharge point are estimated to be 46.5 and 51.1, respectively. Predictions of in-pit water quality and downstream concentrations in Moose River are provided in Table 7.27, below.

Table 7.27 Predicted Water Quality in Effluent and Moose River Downstream of Open Pit Spillway, Active Closure Phase (Stantec 2021d; Appendix D.5)

Parameter	Baseline 75th Percentile Concentration in Moose River (mg/L)	Predicted Treated Effluent Concentration (mg/L)	Predicted Concentration in Moose River (mg/L)		CCME FAL (mg/L)	MDMER Sched. 4 Table 2 (mg/L)
			100 m	120 m		
Dissolved Sulphate	<2	384	9.24	8.5	-	-
Total Aluminum	**0.187**	0.0954	**0.185**	**0.185**	0.1	-
Total Silver	<0.0001	0.0000458	4.99E-05	4.99E-05	0.0001	-
Total Arsenic	**0.0178**	**0.3**	**0.0238**	**0.0233**	0.005	0.3
Total Calcium	1.3	109	3.62	3.41	-	--
Total Cadmium	1.90E-05	1.64E-05	1.89E-05	1.89E-05	1.10E-04	-
Total Cobalt	<0.0004	0.0793	0.0019	0.00175	-	-
Total Chromium	<0.001	0.00057	0.000502	0.000501	-	-
Total Copper	<0.002	**0.0442**	0.00193	0.00185	0.002	0.3
Total Iron	**0.617**	0.0583	**0.605**	**0.606**	0.3	-
Total Mercury	<0.000013	0.0000209	6.81E-06	6.78E-06	0.000026	-
Total Magnesium	0.52	13.9	0.808	0.782	-	-
Total Manganese	0.07	0.173	0.0707	0.0705	-	-
Total Molybdenum	<0.002	0.0101	0.0012	0.00118	0.073	-
Total Nickel	<0.002	0.02	0.00141	0.00137	0.025	0.5
Total Lead	<0.0005	0.000334	0.000252	0.000252	0.001	0.1
Total Antimony	<0.001	0.0047	0.00059	0.000582	-	-
Total Selenium	<0.001	**0.00111**	0.000513	0.000512	0.001	-
Total Titanium	<0.0001	0.0000583	5.02E-05	5.02E-05	0.0008	-
Total Uranium	<0.0001	0.00482	0.000153	0.000143	0.33	-
Total Zinc	<0.005	0.00391	0.00253	0.00253	0.03	0.5
WAD Cyanide	<0.003	**0.15**	0.00469	0.00441	0.005	-
Total Cyanide	<0.005	0.428	0.0117	0.0108	-	0.5
Nitrate (as N)	0.05	10.4	0.276	0.256	13	-
Nitrite (as N)	<0.01	**1.93**	0.0464	0.0427	0.06	-
Total Ammonia-N	0.06	0.635	0.0743	0.0732	-	-

Effluent concentrations of arsenic, copper, selenium, and nitrite are proposed to exceed CCME FAL guidelines at the point of discharge in Year 9. Weak Acid Dissociable (WAD) cyanide concentrations are also above the CCME FAL guideline of 0.005 mg/L for free cyanide. Arsenic concentrations in the effluent are predicted to be 1.05 mg/L initially, and gradually decrease over time in Year 9 based on climate normal conditions. However, as this would exceed the 0.3 mg/L MDMER limit for mine effluent, treatment to at least this limit was assumed for the assessment of assimilative capacity. Mixed with the background water quality of Moose River, the concentration of arsenic 120 m downstream of SW-2 is predicted to be 0.0233 mg/L. Although this arsenic concentration is above the NSECC Tier 1 and CCME guidelines of 0.005 mg/L, the background levels at SW-2 also exceed the guidelines at 0.0178 mg/L. Using the CCME protocol for development of water quality guidelines (CCME 2003), an SSD approach was used to develop a site-specific water quality objective (SSWQO) for arsenic (Intrinsik 2019, attached as SD 22). The value developed is 0.030 mg/L (30µg/L) and concentrations predicted in the receiving environment of Moose River are below this value.

Concentrations of copper (0.0442 mg/L > 0.002 mg/L), selenium (0.00111 mg/L > 0.001 mg/L) and nitrite (1.93 mg/L > 0.06 mg/L) are predicted to exceed CCME FAL guidelines in pit effluent but are predicted to be well below guideline values in Moose River, at a location 100 m downstream of the Open Pit spillway.

Cyanide concentrations in the receiving environment were also predicted. Weak acid dissociated (WAD) cyanide concentrations were predicted to be lower than the existing CCME guideline for free cyanide of 0.005 mg/L. Total cyanide concentrations which can include a mixture of Strong Acid Dissociable (SAD), WAD and free cyanide complexes, were also predicted to be lower than the CCME guideline (free cyanide), implying that free cyanide will be lower than the CCME guideline.

Concentrations of aluminum and iron were both predicted to exceed the CCME FAL guideline at 120 m downstream; however, both parameters are predicted to be below CCME FAL guidelines in pit effluent. Downstream exceedances are attributed to background concentrations in the receiving waters of Moose River. Both the aluminum and iron concentrations are predicted to be below the 75th percentile baseline receiving water quality in Moose River.

With the exceptions of arsenic, aluminum, and iron, all of which have elevated baseline concentrations as previously discussed, water quality in Moose River is expected to meet CCME FAL within 120 m downstream of the Open Pit FDP. Treatment of Open Pit overflow will be provided such that effluent will not exceed MDMER limits.

The water level in the Open Pit will be maintained below the spillway elevation while treatment of the pit lake water quality is required to avoid the potential for uncontrolled releases. A proposed pit lake elevation of 104 m during this period is proposed to provide more than adequate storage of water generated from storm and melt events as the lowest Open Pit level at surface is at 108 m elev. As the Open Pit will have approximately 14.8 m of water cover over the final in-pit Touquoy tailings elevation assuming a spillway invert of 108 m, the potential for settled tailings to be resuspended due to wind or wave action is unlikely with little potential of tailings deposited in the exhausted Open Pit to migrate to Moose River. This water cover over the deposited tailings will limit sulphide oxidation thus reducing metal leaching from sulphides and further improving water quality in the Open Pit. Open Pit water quality is predicted to require treatment to closure regulatory discharge criteria until Year 30. During this time AMNS will treat Open Pit overflow to closure regulatory discharge limits using either a mechanical water treatment plant such as the ETP or potentially implementing passive water treatment. Passive water treatment could take the form of a vertical flow permeable bioreactor or other forms of “engineered wetland” systems. A passive treatment system with adequate carbon substrate could potentially treat

Open Pit overflow to closure regulatory criteria long enough for pit water quality concentrations to stabilize at closure regulatory criteria. AMNS will explore this alternative via its closure planning activities.

As the pit water is planned to be treated to regulatory closure criteria or site-specific guidelines prior to discharge, the magnitude of the effect is expected to be low on Moose River quality and downstream tributaries.

Summary

With the installation of water management features to divert or treat surface water flow as described above to compensate for water quality changes due to the Clay Borrow Area expansion and the construction and operation of the proposed Plant Access Road, residual effects on a change in surface water quality as a result of these Project components are predicted to be negligible. Residual effects associated with the in-pit tailings disposal to Moose River and WRSA flow return to Watercourse #4 are expected to be low in magnitude. Treatment of effluent prior to discharge will be employed where described and as required. Effluent will comply with MDMER requirements at the FDPs. Exceedances of IA Water Quality thresholds are anticipated for select parameters, however baseline water quality is already exceeding these thresholds for these parameters or is limited to areas as described. Changes in surface water quality are expected to be contained within the boundaries of the LAA and to be dissipated within the mixing zones of each respective water body. Based on the above, with effects avoidance, mitigation and environmental protection measures, the residual effect of a change in surface water quality is predicted to be not significant.

7.8 FOLLOW-UP AND MONITORING

The Phase 1 EEM program will be updated to address the proposed Project activities. Monitoring as per MDMER and IA requirements will take place at FDPs associated with flow return to Watercourse #4 Closure/Post-closure monitoring will be completed in accordance with Closure Planning approvals. Downstream monitoring will continue in Watercourse #4 at SW-19, and SW-3 to characterize water quality downstream of the WRSA FDP. A new monitoring location is proposed for Moose River downstream of the Open Pit spillway discharge location once the spillway becomes active (Year 9). This monitoring location will be used to characterize water quality downstream of the spillway. Site accessibility will be a criterion in location selection.

8.0 FISH AND FISH HABITAT

Fish and fish habitat was selected as a valued component (VC) as it provides ecological, cultural, recreational, and economic value to stakeholders including the public, Indigenous groups, local businesses, and government agencies. Fish and fish habitat are protected by federal and provincial legislation.

The federal *Fisheries Act* is administered primarily by DFO with some provisions administered by ECCC. The *Fisheries Act* includes prohibitions against works, undertakings or activities that result in the harmful alteration, disruption, or destruction (HADD) of fish habitat (section 35(1)). Works can be approved by and carried out in accordance with conditions established by the Minister of Fisheries, Oceans, and the Canadian Coast Guard (Fisheries Minister) (section 35(2)(b)).

The *Fisheries Act* also prohibits the carrying out of a work, undertaking or activity, other than fishing, that results in the death of fish (section 34.4(1)), subject to certain exemptions including under an authorization from the Fisheries Minister (section 34.4(2)(b)).

Sections 36(3) and (4) of the *Fisheries Act* prohibits the deposition of deleterious substances into waters frequented by fish in Canada unless authorized by regulation. The MDMER under the *Fisheries Act* regulate the deposit of deleterious mine effluents, tailings and waste rock into waters frequented by fish, as authorized by ECCC (ECCC 2012). The MDMER applies to metal and diamond mines with an effluent flow rate of greater than 50 m^3/d based on effluent deposited from all final discharge points of the mine. In addition, all mines subject to MDMER are required to conduct acute lethality testing of final effluent, effluent characterization, and EEM in the receiving environment.

Under the provincial *Environment Act*, approval is required for the use or alteration of a watercourse, water resource or wetland unless exempted by specific criteria as outlined in the Activities Designation Regulations.

Fish and fish habitat have the potential to be affected by Project-related changes to groundwater resources (Section 6.0), surface water resources (Section 7.0) and terrestrial environment (e.g., wetlands) (Section 9.0) through effects such as the removal of riparian vegetation, alterations to stream flow, introduction of sediments and contaminants of potential concern (COPC), alteration of groundwater quantity and quality, and water management activities that result in changes in water levels in surrounding waterbodies. Therefore, residual effects predicted for groundwater, surface water, and terrestrial environment were used to inform potential Project-related effects on fish and fish habitat.

8.1 POTENTIAL EFFECTS, PATHWAYS AND MEASURABLE PARAMETERS

Table 8.1 lists the potential Project effects on fish and fish habitat and provides a summary of the Project effect pathways and measurable parameters to assess potential effects. Potential environmental effects and measurable parameters were selected based on review of recent assessments for similar projects in Nova Scotia and other parts of Canada, and professional judgment.

Table 8.1 Potential Effects, Effects Pathways and Measurable Parameters for Fish and Fish Habitat

Potential Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Fish Habitat Quantity	• Loss due to water management infrastructure or pit filling • Change in watershed area, water level or flow	• Area (m^2) of habitat loss
Change in Fish Habitat Quality	• Alteration of riparian vegetation • Use of industrial equipment in or near water • Change in watershed area, water level or flow • Release of deleterious substances • Mine waste / rock disposal • Wastewater management	• Physical habitat characteristics (i.e., substrate) • Monthly discharge and water level • Water quality – Total suspended solids (TSS) (mg/L) – Turbidity (NTU) – Trace metals (µg/L) – Nutrients (i.e., ammonia) – pH – Dissolved oxygen (DO) (mg/L) – Water temperature (°C)
Change in Fish Health and Survival	• Changes in water quality (contaminants) • Change in water level or flow (stranding) • Water extraction causing impingement	• Abundance (number of fish) • Mortality (number of fish) • Sublethal effects including reproduction, growth, and survival

8.2 BOUNDARIES

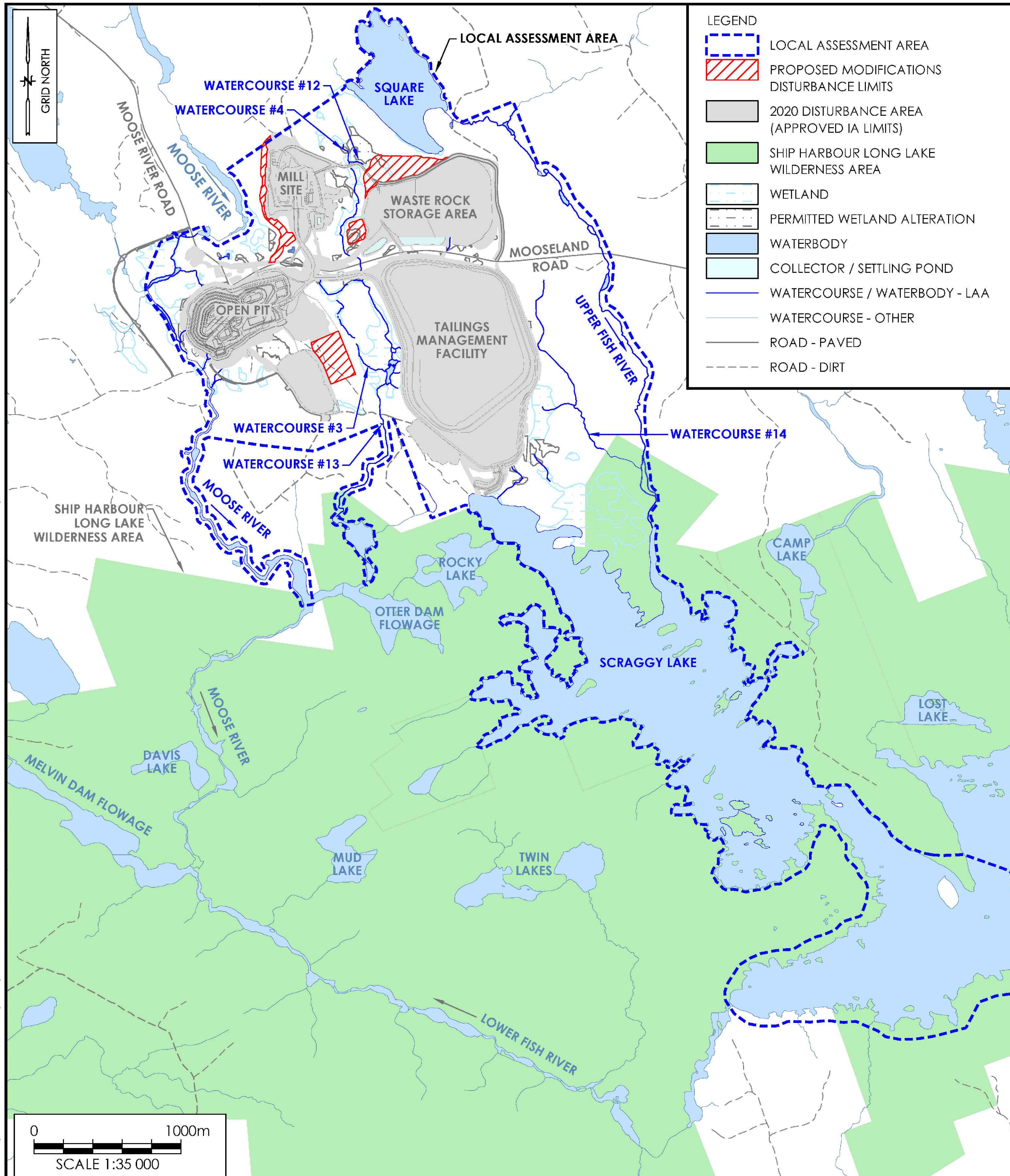
8.2.1 Spatial Boundaries

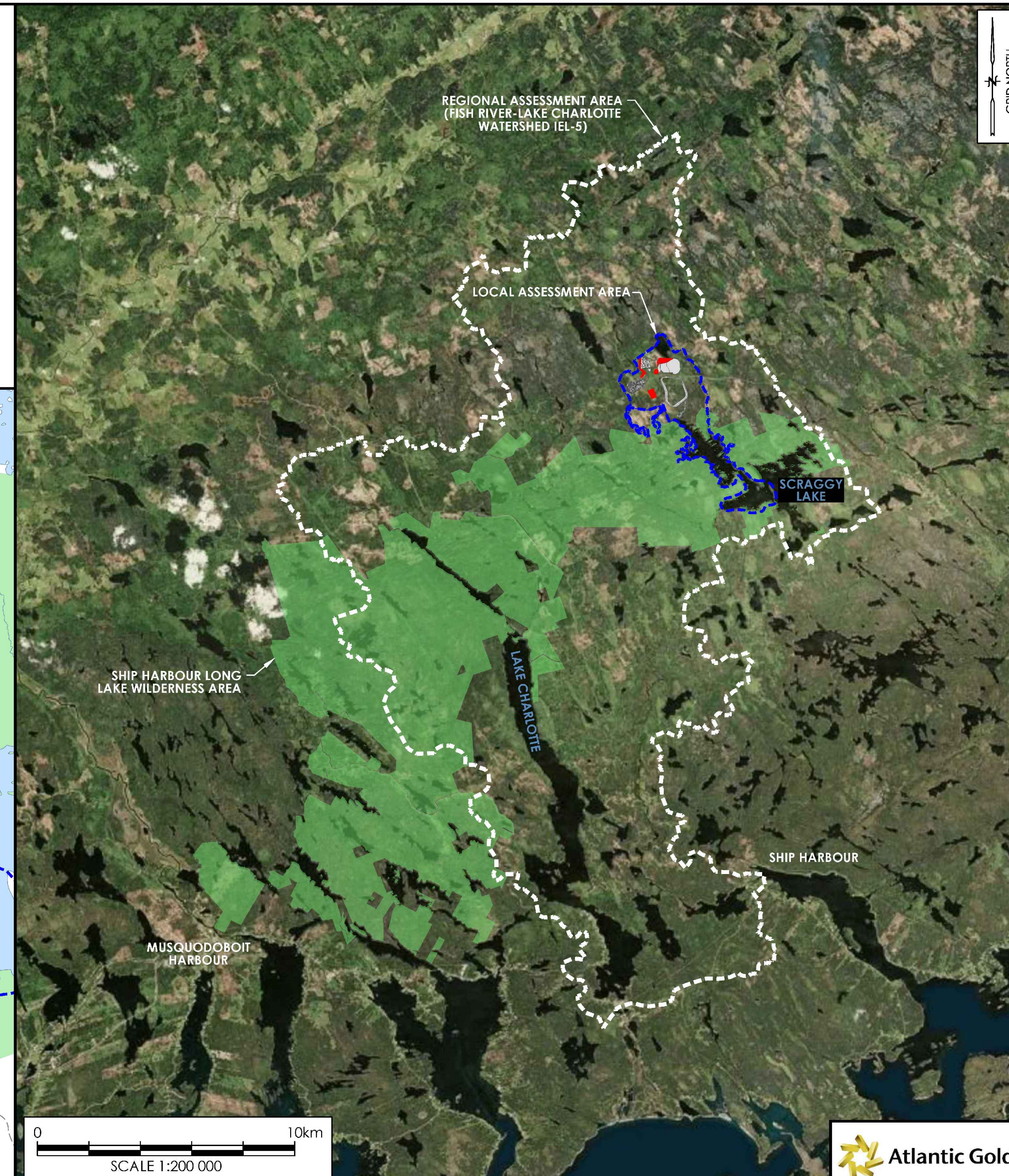
Spatial boundaries for the Fish and Fish Habitat VC were selected in consideration of the geographic extent over which Project activities and their effects are likely to occur on the VC. These spatial boundaries are consistent with the Surface Water Resources VC (Section 7.0).

Project Development Area (PDA): The PDA represents the anticipated area of direct physical disturbance associated with construction, operation and decommissioning of the Project. It comprises the existing Open Pit, the WRSA expansion area the new Clay Borrow Area, the RoW of the relocated Plant Access Road, and the area required for ancillary features associated with these Project components (e.g., ditching, monitoring wells, parking lot security guard house).

Local Assessment Area (LAA): The LAA encompasses the area within which Project-related environmental effects can be predicted or measured for assessment. The LAA for fish and fish habitat incorporates the PDA, Watercourse #4 to Otter Dam Flowage (including Watercourse #3 and its unnamed tributaries), Square Lake, Scraggy Lake, upper Fish River, and Moose River as shown in Figure 8.1.

Regional Assessment Area (RAA): The RAA incorporates the PDA and LAA and encompasses the entirety of the Fish River-Lake Charlotte Watershed (IEL-5) which includes Moose River, lower Fish River, Scraggy Lake and Lake Charlotte.





Atlantic Gold

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Reference:

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2. SITE DATA PROVIDED BY ATLANTIC MINING NS INC. AND McCALLUM ENVIRONMENTAL.
3. IMAGE: BING (EARTHSTAR GEOGRAPHICS SIO).

LOCAL ASSESSMENT AREA AND REGIONAL ASSESSMENT AREA FOR FISH AND FISH HABITAT

TOUQUOY GOLD PROJECT
HALIFAX COUNTY, NOVA SCOTIA

Client: ATLANTIC MINING NS INC.

Job No.:	121619250
Scale:	AS SHOWN
Date:	06-JUL-2021
Dwn. By:	JL
App'd By:	JR

Fig. No.: 8.1

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8.2.2 Temporal Boundaries

The temporal boundaries for the assessment of effects on fish and fish habitat include the construction phase, operation phase, and closure phase, which includes the decommissioning and reclamation stage, and post-closure stage; the project schedule is provided in Section 2.5.

8.3 SIGNIFICANCE DEFINITION

For the purposes of this EARD, a significant residual environmental effect on fish and fish habitat is defined as a measurable Project-related effect that results in:

- A Project-related HADD of fish habitat or the death of fish, as defined by the *Fisheries Act* that cannot be mitigated, authorized, or offset which results in a change in the productivity or sustainability of fish populations within the LAA where recovery to baseline is unlikely.

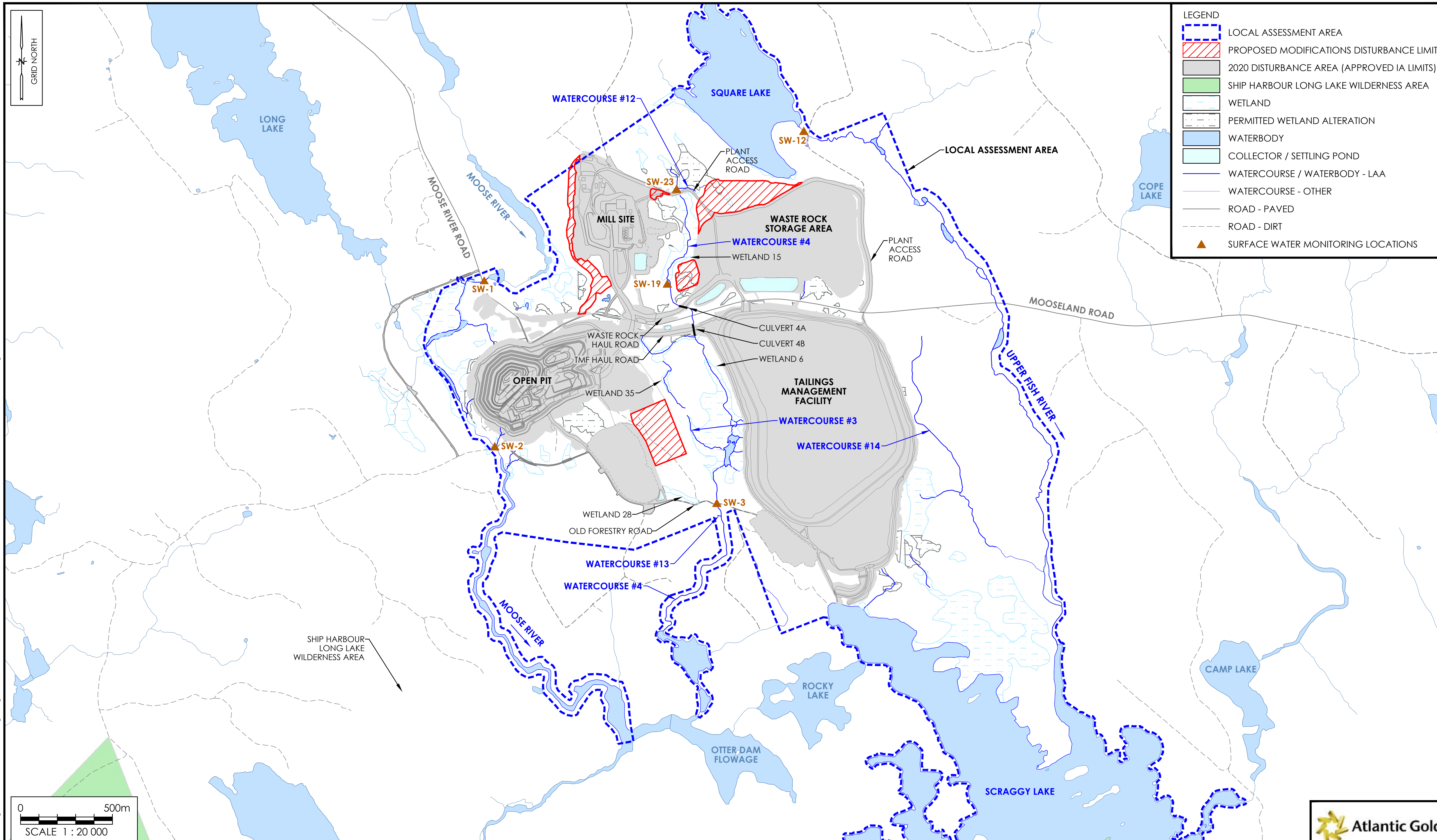
8.4 BASELINE CONDITIONS

8.4.1 Fish Habitat

8.4.1.1 Pre-Development Conditions

The Touquoy Mine site has numerous lakes, ponds, streams, and wetland areas (CRA 2007a), and lies within the Moose River watershed. Parts of Moose River and Watercourse #14 within the LAA are within the Ship Harbour Wilderness Area.

The pre-development conditions of watercourses and waterbodies that may interact with the Project are described below. The pre-development time period is prior to 2016 when construction was initiated (June 2016), with the exception of water quality which is considered prior to October 2017. For some watercourses and waterbodies, surveys were conducted following construction of the Touquoy Mine Site, however the if physical conditions were unchanged they were used to inform the pre-development condition. The watercourses and waterbodies described below are identified in Figure 8.2.



V:\1216\active\121619250\1_geotechnical\3_drawings_logs\2500_TOUQUOY\4_Sheet_Files\12_TASK-2600-EA\121619250.2600_EA_F8.2_REV0.dwg

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

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2. SITE DATA PROVIDED BY ATLANTIC MINING NS INC. AND McCALLUM ENVIRONMENTAL.

WATERCOURSES AND WATERBODIES WITHIN THE LOCAL ASSESSMENT AREA

TOUQUOY GOLD PROJECT
HALIFAX COUNTY, NOVA SCOTIA

Client: ATLANTIC MINING NS INC.

Job No.:	121619250
Scale:	1 : 20 000
Date:	06-JUL-2021
Dwn. By:	JL
App'd By:	JR
Fig. No.:	8.2

Atlantic Gold

Stantec

Watercourse #4

Watercourse #4 is a small second order stream that discharges into Moose River within the Fish River-Lake Charlotte Watershed (Stantec 2019c). Within the PDA, watercourse #4 flows through Wetlands 6 and 15. Fish habitat in Watercourse #4 generally consists of swift moving sections of water with small boulder and organic substrates along with slow-moving pond-like sections (i.e., WL 6) with organic/fine sediments and aquatic vegetation (Stantec 2019c).

Water quality has been monitored at several stations in Watercourse #4 (SW-3, SW-19, SW-23) by AMNS since March 2016 (Figure 7.4). In situ water quality measurements have been collected at these stations since August 2017. The water quality of freshwater environments is generally characterized in relation to CCME “Canadian Environmental Quality Guidelines: Water Quality Guidelines for the Protection of Aquatic Life (Freshwater)” (CWQG FAL) (CCME 2021). The surface water pH in Watercourse #4 ranged from 4.93 and 7.45 from August 2017 to October 2017, with several instances when pH was below the CWQG FAL minimum 6.5, while never measured to be above the CWQG FAL maximum pH of 9 (Stantec 2018a). Water temperature in Watercourse #4 ranged from 7.7 to 20.1°C during this same period (Stantec 2018a) and is considered to be generally suitable for coolwater fish species such as yellow perch (*Perca flavescens*). No pre-development water quality data on surface water DO concentrations in Watercourse #4 are available.

As described in the Surface Water VC (Section 7.0), elevated concentrations of some metal parameters (i.e., aluminum, arsenic, cadmium, cobalt, copper, iron, lead, manganese, silver, vanadium, and zinc) have been noted during the pre-development condition when compared to the CWQG PAL or (NSECC Tier 1 Environmental Quality Standards (NSECC Tier 1 EQS).

Watercourse #12

The Watercourse #12 is a small first order headwater stream located upstream of the Plant Access Road and flows west into Watercourse #4 (MEL 2021b).

Watercourse #12 is formed where two drainage features from Wetland 15 converge, and this channelized tributary has variable substrate including sections with complete organic or muck substrate and sections that are predominantly gravel, sand, and cobble (MEL 2021b). The width of this tributary ranges between 0.8 and 1.6 m and depth ranges between 8 and 54 cm (MEL 2021b). The flow becomes more diffuse as it flows into Watercourse #4, and there were isolated patches of standing water ranging from 3 to 7 cm in depth in December 2020 (MEL 2021b). This tributary is at least seasonally contiguous with Watercourse #4 and is accessible by fish (MEL 2021b). The fish habitat quality and potential species present are limited because of intermittent flow, standing pools of stagnant water, mucky substrates, and potentially elevated water temperatures during low flow periods (MEL 2021b).

Consequently, the abundance and diversity of fish species that may use this tributary are considered to be low (MEL 2021b).

Although no pre-development water quality monitoring data are available for Watercourse #12 specifically, it is anticipated that the water quality would be similar to the upper reaches of Watercourse #4.

Watercourse #13

Watercourse #13 is a small first order headwater stream within the Watercourse #4 catchment. A channel upwells from the ground and forms a single defined channel for approximately 15 m before discharging into the western side of Watercourse #4. It contains organic and fine substrates and would be considered fish habitat (Stantec 2019d). Upstream of the defined channel, there are a series of poorly connected pools of wetland seepage which drains through Wetland 28 which are not considered fish habitat.

No pre-development water quality monitoring data are available for Watercourse #12; however, it is anticipated that the water quality would be similar to the upper reaches of Watercourse #4.

Watercourse #3

Watercourse #3 is a small first order headwater stream within the Watercourse #4 catchment. The upper reaches are intermittent and flow underground. The perennial portion of the stream flows for approximately 315 m before discharging along the western side of Watercourse #4 within Wetland 6. The stream consists of flowing habitats which range in width from ~1.5 to 2.0 m. Substrates were a mix of fine and coarse substrates depending on the habitat unit. Riparian areas varied along the length of the watercourse #4 (e.g., wetland, shrub, forest).

No pre-development water quality monitoring data are available for Watercourse #3; however, it is anticipated that the water quality in Watercourse #3 would be similar to the upper reaches of Watercourse #4.

Square Lake

Square Lake is located to the north of the existing WRSA. It is located within the headwaters of the Scraggy Lake Watershed and has a surface area of approximately 33 ha and a maximum depth of approximately 4 m (CRA 2007a). It has no significant surface water inputs from watercourses but likely has significant groundwater inputs (CRA 2007a). The outlet of Square Lake is the upper part of Fish River which drains into Scraggy Lake (CRA 2007a).

Although no pre-development water quality monitoring data are available for Square Lake, it is expected that water quality in Square Lake would be similar to that of upper Fish River, described below.

Upper Fish River

Upper Fish River flows from Square Lake to Scraggy Lake for approximately 3,650 m along the eastern side of the existing Touquoy Mine site. The gradient is low and no substantial changes in elevation that would indicate barriers to fish passage were noted. Based on aerial imagery, the stream consists of narrow reaches (~1 to 5 m in width) and fiver larger stillwaters/steadies (~10 to 45 m in width)

(Maxar 2020). The narrow reaches of upper Fish River typically flow through forested riparian areas, while larger stillwaters/steadies are often associated with wetland riparian habitats. Based on other field surveys in the area, the narrow reaches of upper Fish River likely consist of riffle/run habitat with a few small pools and coarse substrates (i.e., gravel, cobble, boulder). The larger stillwaters/steadies are likely deeper, slower flowing areas with finer substrates.

Based on water quality monitoring at SW-12 (Figure 7.4), the surface water pH in upper Fish River ranged from 5.02 and 6.36 from August 2017 to October 2017 and was always observed to be below the CWQG FAL recommended minimum pH of 6.5 (Stantec 2018a). Water temperature in upper Fish River ranged from 9.5 to 21.4°C during this same period (Stantec 2018a) and is considered to be generally suitable for coolwater fish species such as yellow perch. No pre-development water quality data on surface water DO concentrations are available for upper Fish River.

As described in the Section 7.0 (Surface Water VC), elevated concentrations of some metal parameters (i.e., aluminum, cadmium, iron, and zinc) have been noted during the pre-development condition when compared to the CWQG PAL or NSECC Tier 1 EQS.

Watercourse #14

The Watercourse #14 flows for approximately 1,450 m from the eastern side of the existing TMF to upper Fish River. The gradient appears to be low and no substantial changes in elevation that would indicate barriers to fish passage were noted. Based on aerial imagery, the stream consists of narrow reaches (~1 to 5 m in width) (Maxar 2020). The narrow reaches of the Watercourse #14 flows through forested riparian areas and then lower wetland/shrub riparian areas prior to flowing into upper Fish River. Based on other field surveys in the area, the narrow reaches of Watercourse #14 likely consist of riffle/run habitat with a few small pools and coarse substrates (i.e., gravel, cobble, boulder).

Based on water quality monitoring at SW-20 (Figure 2.1), the surface water pH in Watercourse #14 ranged from 6.37 and 6.88 from August 2017 to October 2017 and was sometimes below the CWQG FAL recommended minimum pH of 6.5 and was not observed to be above the recommended maximum pH of 9 (Stantec 2018a). Water temperature in Watercourse #14 ranged from 10.9 to 19.1°C during this same period (Stantec 2018a) and is considered to be generally suitable for coldwater fish species such as brook trout (*Salvelinus fontinalis*). No pre-development water quality data on surface water DO concentrations are available for Watercourse #14 are available.

As described in Section 7.0 (Surface Water VC), elevated concentrations of some metal parameters (i.e., aluminum, arsenic, cadmium, copper, iron, lead, mercury, vanadium, and zinc) have been noted during the pre-development condition when compared to the CWQG PAL or NSECC Tier 1 EQS.

Scraggy Lake

Scraggy Lake has a surface area of 644.5 ha (CRA 2007a). Scraggy Lake is characterized by many small coves and islands and has a shoreline length of 52,558 m (CRA 2007a). The maximum depth of Scraggy Lake is approximately 13.0 m. Most of the lake is less than 6 m deep and has an average depth of 3 m (CRA 2007a).

Scraggy Lake water levels are controlled, in part, by an old wooden dam structure at its outlet to lower Fish River. The structure measures approximately 35 m in length and 0.6 to 0.9 m in height (GHD 2020). The dam was built or refurbished approximately 30 years ago however the construction was never formally approved (GHD 2020). The dam structure is not owned or maintained by AMNS.

Fish habitat in Scraggy Lake was surveyed in August 2017 (Stantec 2018b). The lake is composed principally of shallow water rocky habitats (<6 m water depth) with sparse amounts of emergent vegetation near the shoreline (e.g., water lilies). Substrate is a mix of cobble, rock, and some sand in littoral areas. Rock outcrops and large boulders are prevalent and the profundal zone is characterized by rich organic flocculent/mucky substrate. The fish habitat in Scraggy Lake is good for species that prefer shallow (<3 m) rocky substrate and structure.

Pre-development surface waters in Scraggy Lake were soft, contained low concentrations of dissolved minerals (i.e., hardness), had low pH and were nutrient poor (CRA 2007a, Stantec 2018b, Stantec 2019e). The surface water pH in Scraggy Lake (based on water quality monitoring at SW-21) ranged from 5.62 and 7.51 from August 2017 to October 2017 and was sometimes below the CWQG FAL recommended minimum pH of 6.5 and was not observed to be above the recommended maximum pH of 9 (Stantec 2018a). These conditions are similar to water quality data collected in October 2000 (CRA 2007a).

A thermocline develops annually in the deeper basins of Scraggy Lake (>5 m). Above the thermocline, the water is well oxygenated and water temperatures typically range between 20-24°C (Stantec 2018b). Below the thermocline the water temperatures are cooler (<13°C) and oxygen concentrations can be reduced (Stantec 2018b).

DO concentrations in Scraggy Lake were highest above the thermocline (7.0 mg/L), indicating well oxygenized waters (Stantec 2018b). DO levels below the thermocline were approximately 2.0 mg/L with the lowest concentrations observed in the deeper sections of the lake (Stantec 2018b).

As described in Section 7.0 (Surface Water VC), elevated concentrations of some metal parameters (i.e., aluminum, cadmium, iron, and lead) have been noted during the pre-development condition when compared to the CWQG PAL or NSECC Tier 1 EQS.

Sediment sampling in Scraggy Lake in 2017 revealed no exceedances of the Canadian Environmental Quality Guidelines (CEQG) Interim Sediment Quality Guidelines (ISQGs) or Probable Effects Levels (PELs) were identified in the sediment samples; however, higher concentrations of aluminum, arsenic and iron were observed at some of the sampling locations (Stantec 2018b). Grain size analyses on the sediment samples collected from Scraggy Lake determined that sand was the dominant substrate followed by gravel, and clay (Stantec 2018b).

During sampling in 2017 and 2018, benthic invertebrates, such as midges (Chironomidae), amphipods, mayflies (Ephemeroptera), caddisflies (Tricoptera) and aquatic beetles (Coleoptera) were abundant within the shallow water littoral zone and midges dominated in deeper mid-water zone (Stantec 2018b; 2019e). Midges occupy many diverse habitat types and can tolerate a wide range of physical and chemical parameters (Mackie 2001).

Moose River

Moose River flows along the western side of the Open Pit and is the largest watercourse adjacent to the Touquoy Mine Site (CRA 2007a). It typically consists of a single channel; however, there are some side channels. The upper and middle stretches are mainly riffle-run, while the lower stretch consists mainly of deeper runs and pools.

Fish habitat surveys conducted in July and November 2020 observed mainly riffle-run habitats in Moose River with an average wetted width was 11.2 m (range 4 to 40 m) and average bankfull width was 12.5 m (4.8 to 40 m) (Stantec 2020d,2020e). Water depths in the main channel ranged from 0.10 to over 1.6 m. Banks were stable at the time of the surveys and riparian vegetation was dominated by trees (~55%) and shrubs (~25%). Substrate was dominated by fines (~35%), cobble (~20%) and small boulders (15%) (Stantec 2020d,2020e). CRA (2007a) found that substrate in Moose River was primarily coarse with gravel, cobbles and boulders and very little fines (CRA 2007a). Overhead and instream cover was generally low (<5% and ~20%, respectively) and overhead cover was made up primarily of grasses and instream cover was provided by aquatic vegetation (Stantec 2020d, 2020e).

The surface water pH in Moose River (based on water quality monitoring at SW-1 and SW-2) ranged from 5.42 and 6.88 from August 2017 to October 2017 (Stantec 2018a). Surface water pH was usually below the CWQG FAL recommended minimum of 6.5 and was not observed above the recommended maximum of 9 (Stantec 2018a). Water temperatures in Moose River ranged from 9.0 to 20.0 °C during this same period (Stantec 2018a). No pre-development water quality data on surface water DO concentrations in Moose River are available.

As described in Section 7.0 (Surface Water VC), elevated concentrations of some metal parameters (i.e., aluminum, arsenic, cadmium, iron) have been noted during the pre-development condition when compared to the CWQG PAL or NSECC Tier 1 EQS.

8.4.1.2 Existing Conditions

There have been no noted changes associated with fish or fish habitat in Square Lake, upper Fish River, the Watercourse #14, the Watercourse #13, and Watercourse #3 following the development of the Touquoy Mine. Therefore, the description of pre-development conditions above is still applicable and these locations are not discussed further.

Existing conditions for the remaining watercourses are described below.

Watercourse #12

The flow associated with Watercourse #12 may have slightly increased from pre-development conditions as a result of the construction of the Plant Access which diverts water along the Plant Access Road to the culvert north of the Plant Access Road in Wetland 15.

No water quality monitoring data are available for Watercourse #12, as it was not studied for the original EA.

Watercourse #4

As part of the existing mine development there have been reductions in the catchment area of Watercourse #4 which may have resulted in changes in flow (Section 7.0, Surface Water VC). These were approved and permitted as part of the original EA.

During fish habitat survey in 2019, Watercourse #4 was ephemeral upstream of the Plant Access Road and intermittent for approximately 325 m downstream of the Plant Access Road during summer low flow conditions (Stantec 2021h). Ephemeral and intermittent flow conditions are typical of small headwater streams. There have been changes in the substrates in Watercourse #4 as a result of siltation events associated with the haul roads between 2018 and 2020 (Stantec 2019c). Grey silt, consistent with what accumulates on the mine roads, was observed in depositional areas of Watercourse #4 and was most evident in areas immediately downstream of the WRSA haul road at Culvert 4A and TMF haul road at Culvert 4B and within the slow-moving sections of Watercourse #4, where it flows through Wetland 6. Grey silt appeared to have replaced the fine substrates (i.e., organics) between coarser substrates in swift-flowing sections (Stantec 2019c). Monitoring conducted in 2020 within Watercourse #4 showed that the substrates in Watercourse #4 are generally returning to pre-siltation characteristics or are stable (Stantec 2021h).

Based on water quality monitoring at SW-3, SW-19 and SW-23 in Watercourse #4 and fish habitat surveys conducted in 2019, the surface water pH in Watercourse #4 ranged from 3.97 to 8.52 from November 2017 to March 2021 and was sometimes below the CWQG FAL recommended minimum of 6.5 and was not observed to be above the recommended maximum of 9 (Stantec 2018a, 2019b, 2020c, 2021f). Low pH is characteristic of the watercourses in the RAA and in the general region (Stantec 2019c).

Water temperature in Watercourse #4 reached a maximum of 22.2°C during this same period (Stantec 2018a, 2019b, 2020c, 2021f). The highest water temperatures observed during fish habitat surveys conducted in August 2019 were within the slow-moving sections of Watercourse #4 and reached a maximum of 27.7 °C (Stantec 2019c). The temperatures in Watercourse #4 are generally suitable for coolwater fish species such as yellow perch and elevated temperatures in slow-moving sections are more suited to warmwater species such as white sucker and brown bullhead. The swift flowing reaches of Watercourse #4 appear to be cooler than the sections and may be more suitable for coldwater species such as brook trout.

The surface water DO levels in Watercourse #4 ranged from 6.02 to 14.36 mg/L in water quality monitoring data collected from January 2020 to March 2021 and were typically above the CWQG FAL recommended minimum DO levels of 6.0 mg/L and 5.5 mg/L for warm-water species (early and other life stages) (Stantec 2018a, 2019b, 2020c, 2021f). Lower dissolved oxygen concentrations have been noted during intermittent flow conditions in the upper reaches of Watercourse #4 (Stantec 2019e). The minimum recommended DO of 6.5 mg/L for cold-water species (other life stages) is typically met (Stantec 2018a, 2019b, 2020c, 2021f). The minimum recommended DO of 9.5 mg/L for cold-water species (early life stages) was not met some of the time (Stantec 2018a, 2019b, 2020c, 2021f).

As described in Section 7.0 (Surface Water VC), elevated concentrations of some metal parameters (i.e., aluminum, arsenic, cadmium, copper, iron, manganese) have been noted during the existing condition when compared to the CWQG PAL or NSECC Tier 1 Environmental Quality Standards (NS ECC Tier 1 EQS). It should be noted that these parameters were elevated during the baseline condition. Seepage from the existing WRSA appears to be a source of elevated sulphate concentrations within Watercourse #4 (Stantec 2021f; SD 19a).

Targeted silt samples and sediment samples were collected from Watercourse #4 in 2019 (Stantec 2019c). Sediment samples generally reflected the local geology of soils and surface rock in regards to concentrations of arsenic, iron and manganese. Targeted silt samples were similar to metal concentrations in samples of sediment that were unaffected by siltation events (Stantec 2019c).

Watercourse #13

Occasional exceedances of the Tier 1 EQS in the Watercourse #13 were noted for aluminum, arsenic, cadmium, copper, iron, and manganese. Elevated concentrations of these parameters are common in Nova Scotia due to surface and underlying geology that contains traces of these metals (Stantec 2019d); observed concentrations were within the baseline ranges for Watercourse #4. Arsenic was below the site-specific criterion of 30 µg/L for water established for the Site (Stantec 2019d).

Scraggy Lake

Mine effluent is deposited to Scraggy Lake which flows into the lower Fish River and through the Ship Harbour Wilderness Area within the RAA.

Overall, the physical fish habitat in Scraggy Lake is not noticeably different from pre-development conditions. Substrates are similar to pre-development conditions and weed beds are present. In the northwestern arm of the lake, the two changes from pre-development conditions are a permitted water withdrawal pipe with a permanent silt curtain and discharge of mine effluent into the receiving environment through a constructed wetland.

In the northwestern basin the discharge of treated effluent does not appear to be impairing the water quality in Scraggy Lake (Stantec 2021h). Effluent is discharged for approximately five to eight months of the year. During a period of effluent discharge in 2020, effluent concentration in the nearfield exposure area was estimated using conductivity as a tracer and ranged between 5 and 28% within 100 m of the final discharge point and extended to the outlet of Scraggy Lake (<1%). During the same timeframe in 2020, the relative effluent concentration at the southern extent of the northeastern basin was negligible.

Based on water quality monitoring at SW-21 in the northwestern basin, the surface water pH in Scraggy Lake ranged from 6.24 and 8.22 from July 2018 to March 2021 and was rarely below the CWQG FAL recommended minimum of 6.5 and was not observed to be above the recommended maximum of 9 (Stantec 2019b, 2020c, 2021f). Water temperature in Scraggy Lake reached a maximum of 26.8 °C during this same period (Stantec 2019b, 2020c, 2021f) and is generally suitable for coolwater and warmwater fish species such as yellow perch, white sucker, and brown bullhead.

The surface water DO concentration in Scraggy Lake ranged from 8.2 to 13.71 mg/L from January 2020 to March 2021, was always above the CWQG FAL recommended minimum DO of 6.5 mg/L for cold-water species (other life stages) and above the recommended minimum DO levels of 6 mg/L and 5.5 mg/L for warm-water species (early and other life stages) (Stantec 2019b, 2020c, 2021f). The measured DO in Scraggy Lake was below the minimum recommended DO of 9.5 mg/L for cold-water species (early life stages) some of the time (Stantec 2019b, 2020c, 2021f).

Similar to pre-development conditions, benthic invertebrate taxa collected from the mid-water zone were dominated by dipterans such as chironomids (i.e., midges). Chironomids occupy many diverse habitat types and can tolerate a wide range of physical and chemical parameters.

Moose River

The physical fish habitat in Moose River is not noticeably different than during pre-development. During a fish habitat surveys in 2020, no redds were observed and no areas of preferable Atlantic salmon spawning habitat were observed in the upper and lower reach of Moose River (Stantec 2020d, 2020e). In 2020, it was determined that, overall, the physical habitat characteristics of Moose River are suitable for various life stages of salmonid species, though water quality, and specifically low pH, may reduce the habitat quality for salmonids to carry out their life processes (Stantec 2020d, 2020e).

Although there is the potential for slight reductions in flow as a result of groundwater drawdown to the Open Pit, these changes are not of sufficient magnitude to negatively affect fish populations (Stantec 2021i; SD24). AMNS has undertaken additional monitoring and studies to collect additional information to better assess the potential flow reductions in Moose River.

Water quality in Moose River is generally suitable for coolwater fish species such as yellow perch. Based on water quality monitoring at SW-1 and 2, the surface water pH in Moose River ranged from 3.6 to 8.2 from November 2017 to March 2021 and was often above the CWQG FAL recommended minimum pH of 6.5 and was not observed above the recommended maximum pH of 9 (Stantec 2018a, 2019b, 2020c, 2020d, 2020e). Although Atlantic salmon are present and brook trout are assumed to be present in Moose River, low pH values (<6.5) observed during a fall fish habitat survey in 2020 (Stantec 2020e) have the potential to result in decreased hatching success for Atlantic salmon and brook trout (Haines 1981; Menendez 1976). Baseline pH was similarly low.

Water temperatures in Moose River may reach a maximum of 28°C during low flow periods (Stantec 2020d) and this is generally suitable for coolwater fish species such as yellow perch. This maximum temperature is outside of the preferred water temperature range for Atlantic salmon; however, Atlantic salmon are known to occur in Moose River and may use the habitat seasonally or seek thermal refugia if water temperatures exceed their thermal tolerance.

Based on water quality monitoring at SW-1 and SW-2, the surface water DO level in Moose River ranged from 7.55 to 14.74 mg/L from January 2020 to March 2021, which is above the recommended minimum DO levels of 6.0 mg/L and 5.5 mg/L for warm-water species (early and other life stages, respectively) and the recommended minimum DO of 6.5 mg/L for cold-water species (other life stages) (hf; SD 19a).

Surface water DO was rarely below the CWQG FAL recommended minimum DO of 9.5 mg/L for cold-water species (early life stages) (Stantec 2021f; SD 19a) and are acceptable for freshwater aquatic life (Stantec 2020e; Stantec 2021f).

Water quality in Moose River at SW-2 is generally consistent with the background water quality (SW-11 and SW-1) (Stantec 2021f; SD 19a). Water quality in Moose River does not appear to be affected by operation at the Site (Stantec 2021f; SD 19a).

8.4.2 Fish Populations

There are thirteen species of fish confirmed to be present in the upper Fish River Watershed. They include alewife (*Alosa pseudoharengus*), American eel (*Anguilla rostrata*), Atlantic salmon/ouananiche (*Salmo salar*), banded killifish (*Fundulus diaphanus*), brown bullhead (*Ameiurus nebulosus*), brook trout, golden shiner (*Notemigonus crysoleucas*), lake chub (*Couesius plumbeus*), ninespine stickleback (*Pungitius pungitius*), northern redbelly dace (*Chrosomus eos*), white perch (*Morone americana*), white sucker (*Catostomus commersonii*) and yellow perch (*Perca flavescens*) (Stantec 2018b, 2019c, CRA 2007a).

All thirteen species except northern redbelly dace were confirmed to be present in Scraggy Lake (Stantec 2018b, 2019e) and are assumed to be present in Square Lake. Scraggy Lake is dominated by cool and warmwater fish species, with the most common species being white sucker and yellow perch (Stantec 2018b, Stantec 2019e, CRA 2007b). Scraggy Lake has historically been stocked with landlocked Atlantic salmon (ouananiche) and brook trout (CRA 2007a). In Scraggy Lake, catch per unit effort for all species ranged from 29.7 to 38.9 fish per net per day for gill nets, 11.4 to 43.6 fish per trap day for minnow traps and 57 to 77.8 fish per trap day for fyke nets (Stantec 2018b and 2019e).

Fish species present in Square Lake has not been confirmed, although limited sampling in August 2007 did not return any fish (CRA 2007b). Given the connectivity between Square Lake and Scraggy Lake via upper Fish River, it is anticipated that the fish species in Scraggy Lake are also present in upper Fish River and Square Lake for at least some portion of the year.

Fish surveys and incidental observations in Watercourse #4 confirmed the presence of American eel, banded killifish, brook trout, brown bullhead, northern redbelly dace and white sucker (Stantec 2019c). Stickleback and northern redbelly dace were confirmed present in Watercourse #3. There were no suitable locations to trap fish in Watercourse #13 as a result of shallow depths, however itis anticipated to have a similar fish community given its small size the connectivity with Watercourse #4.

All thirteen species of fish are also assumed to be present in Moose River given its connectivity with Long Lake based on fish community surveys conducted in Long Lake in 2017 and 2018 (Stantec 2018b, 2019e CRA 2007a).

Moose River provides good physical juvenile and rearing habitat, and potentially spawning habitat for Atlantic salmon where juvenile Atlantic salmon were observed in the area (CRA 2007a). It is also likely that the Atlantic salmon observed in Moose River are landlocked specimens based on the colouring and size of the fish captured and proximity to a known landlocked salmon population in Scraggy Lake (CRA 2007a).

Brook trout are listed as sensitive by the Nova Scotia Department of Natural Resources (NSDNR). It was determined that Moose River provides good adult and juvenile brook trout feeding habitat, fair rearing habitat and potential spawning habitat (CRA 2007a).

Metal concentrations in fish from Scraggy Lake were sampled prior to effluent deposition. Prior to the deposit of effluent in Scraggy Lake, mercury concentrations in whole body white sucker were below the Health Canada commercial fish consumption guideline for human health of 0.5 mg/kg, while whole body and fillets samples from yellow perch were above (maximum = 0.59 and 0.81 mg/kg) (CRA 2007a, Stantec 2018b, 2019e).

8.4.3 Species at Risk

The fish SAR and fish SOCC listed in Table 8.2 have an elevated potential of occurring within the PDA, based on habitat preferences, and known distributions. SAR species are those listed on Schedule 1 of the *Species at Risk Act* (SARA) while SOCC are those species listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). There are no fish species listed on Schedule 1 of SARA that occur within the PDA. There are two fish SOCC that occur within the LAA and no fish species within the LAA that are listed by the *Nova Scotia Endangered Species Act* (NS ESA).

Table 8.2 Species at Risk and Species of Conservation Concern with Potential to Occur in the LAA

Scientific Name	Common Name	SARA (Schedule 1)	COSEWIC	NS ESA
Anguilla rostrata	American eel	Not Listed	Threatened	Not Listed
Salmo salar	Atlantic salmon (sea-run)	Not Listed	Endangered	Not Listed
Salvelinus fontinalis	Brook trout	Not Listed	Not Listed	Not Listed

There have been no species-specific targeted surveys completed in the LAA for SAR or SOCC fish species; however, fish SOCC have been identified within the LAA during watercourse assessments and EEM programs, including American eel and Atlantic salmon. American eel occur throughout the LAA and RAA while sea-run Atlantic salmon are only known to occur in Moose River. The sea-run Atlantic salmon that occur in Moose River are of the Nova Scotia Southern Upland population (DFO 2019a).

There are no species listed on Schedule 1 of SARA with prohibitions, therefore there is no further consideration of SAR fish species. There are no prohibitions related to SOCC listed by COSEWIC.

8.5 PROJECT INTERACTIONS WITH FISH AND FISH HABITAT

Project activities that might interact with fish and fish habitat for each potential effect are identified in Table 8.3. Some of the Project activities that have the potential to interact with surface water that are described in Section 7.5 of the Surface Water VC would also apply to fish and fish habitat.

Table 8.3 Project Interactions with Fish and Fish Habitat

Project Activities	Change in Fish Habitat Quantity	Change in Fish Habitat Quality	Change in Fish Health and Survival
In-Pit Tailings Disposal			
Deposition of Tailings	-	-	-
Water Management	X	X	X
Reclamation and Decommissioning	X	X	X
Waste Rock Storage Area Expansion			
Site Preparation	-	-	-
Operation of the WRSA	-	-	-
Water Management (e.g., modification of water drainage structures; relocation of monitoring well)	X	X	X
Reclamation and Decommissioning	-	X	X
Clay Borrow Area			
Site Preparation	-	-	-
Operation of the Clay Borrow Area	-	-	-
Water Management	X	X	-
Reclamation and Decommissioning	X	X	-
Plant Access Road			
Site Preparation and Construction	-	-	-
Water Management	-	-	-
Operation of Road for Site Traffic	-	-	-
Reclamation and Decommissioning	-	-	-

The following Project activities and components are not expected to result in a change in fish habitat quality, quantity, or fish health and survival as they are located more than 30 m from a watercourse or waterbody:

- physical in-pit deposition of tailings
- site preparation and operation of the WRSA expansion.
- site preparation and operation of the Clay Borrow Area expansion
- site preparation and construction, operation of Road for Site Traffic, and the reclamation and decommissioning of the Plant Access Road.

As described in the Surface Water VC assessment (Section 7), mine-site contact water associated with the WRSA, and Clay Borrow Area must be captured and treated prior to discharge. Potential interactions which result from the capture of surface water outside the 30 m buffer from a watercourse are considered to interact with fish and fish habitat through water management.

8.5.1 Change in Fish Habitat Quantity

As described in the Surface Water assessment (Section 7.0), the construction and operation of the WRSA and Cay Borrow Area and overflow from the in-pit disposal area to Moose River have the potential to result in changes in fish habitat quantity or changes in the timing, duration, and frequency of stream flows. These changes to stream flows may result from modifications to watershed areas and/or flow patterns through the diversion of site contact-water towards water management infrastructure for treatment or through the discharge of treated effluent via engineered spillways.

Alterations in the water balance of Scraggy Lake associated with the Project could affect water level and discharge and result in indirect loss of fish habitat quantity within the littoral zone of the lake or downstream in the downstream portion of lower Fish River. These changes may occur to modifications in watershed area, water withdrawal associated with pit filling and TMF storage, and the termination of effluent discharge during the existing operation and during mine closure.

Connecting the engineered spillway with Watercourse #4 may result in a very small quantity of direct loss of fish habitat within the riparian area and below the ordinary high-water mark.

8.5.2 Change in Fish Habitat Quality

Several Project-related activities could affect fish habitat quality during the life of the Project including the use of industrial equipment, vegetation clearing, working near streams, and water and effluent management.

The WRSA expansion, new Clay Borrow Area and relocated Plant Access Road have been designed to avoid ground disturbance within a 30 m buffer zone of waterbodies. Aside from the engineered discharge associated with the water management pond, there will be no physical alteration of riparian vegetation or use of industrial equipment in or near the water which could otherwise potentially affect fish habitat quality.

During construction of the engineered discharge, an increase in erosion due to removal of riparian vegetation, exposed soils, and changing slopes could increase sediment deposition in fish habitat, thus reducing habitat quality (e.g., siltation of spawning beds) (Greig et al. 2007; Wood et al. 1997; Kemp et al. 2011). Removal of riparian vegetation may reduce shade and/or increase nutrient and energy inputs, which could affect water quality, in turn affecting the quality of fish habitat through changes in temperature and food availability (i.e., primary and secondary productivity) (Zalewski et al. 2001).

The timing of construction can also influence fish habitat quality. For example, construction of the engineered spillway near Watercourse #4 during high flow or increased rainfall events could increase the potential for runoff and the amount of sediment entering fish habitat.

During operation and rehabilitation and closure, runoff, seepage and discharges from the new water management pond and in-pit tailings disposal area into the aquatic environment could affect fish habitat quality (i.e., water and sediment quality) if suspended sediments, COPC, or nutrients are released (Sweka and Hartman 2001; Herbert and Merkens 1961; Kjelland et al. 2015). During operation, water management infrastructure in the WRSA will capture runoff and seepage and release treated effluent to Watercourse #4.

Treated effluent released from the in-pit disposal area and water management pond has the potential to be warmer than the receiving waters due to the lacustrine nature of the ponded water. There is the potential for species-specific changes in the quality of fish habitat as a result of temperature changes.

Changes in fish habitat quantity can result in changes in water velocity and depth and therefore affect the suitability or quality of fish habitat.

8.5.3 Change in Fish Health and Survival

The primary Project-related activities that could affect fish health and survival are due to effluent discharge into watercourses and fish accessing the in-pit disposal area during effluent release.

The timing of construction work with heavy equipment below the high-water mark for the engineered discharge could affect fish health and survival due to direct or indirect injury to fish, larvae, or eggs (DFO 2019b).

Removal of riparian vegetation during construction of engineered discharge could affect fish health due to changes in shade, protective cover, and/or external nutrient/energy inputs (Zalewski et al. 2001).

Reductions in flow as a result of changes in habitat quantity could result is fish being stranded.

Introduction of sediments, COPC and nutrients into fish habitat could affect fish health and survival through lethal or sublethal effects. This could occur during construction of the engineered spillway if conducted during periods of high rainfall, which could lead to siltation events that have the potential to inhibit the ability of fish to forage, cause behavioural or physiological changes in fish, and smother eggs (Sweka and Hartman 2001; Herbert and Merkens 1961; Kjelland et al. 2015). Introduction of deleterious substances (e.g., grease, fuel) from machinery operating in or near water could also affect fish health and survival.

The use of explosives may be required to construct the engineered discharge. Instantaneous changes in pressure or physical strike could result in changes to fish health and survival through injury or instantaneous death.

Release of treated effluent to watercourses from the water management pond and in-pit disposal area may affect fish health and survival through the addition of deleterious substances and COPC (e.g., metals, nutrients).

Release of treated effluent from the in-pit disposal area or water management ponds has the potential to result in a change in water temperature within the receiving environment due to the lacustrine nature of the ponded water. Each freshwater fish species has a preferred temperature range, and if released water temperatures are too far above or below this threshold, there is the potential for behavioral changes, physiological stress, or mortality.

The in-pit disposal area is expected to become stratified following closure, and waters in the bottom layers may become anoxic and may contain elevated concentrations of dissolved trace metals as a result of tailings deposition. If the in-pit disposal area turns over, the surface water that is discharged may contain lower levels of DO and elevated concentrations of metals which could affect water quality and thus fish habitat quality in the receiving environment of Moose River.

If fish are able to access the in-pit disposal area via the engineered spillway there is the potential for acute lethality and sublethal effects to fish within the in-pit disposal area.

8.6 MITIGATION

Project planning and design and the application of proven mitigation measures will be used to reduce adverse effects to fish and fish habitat. AMNS has developed a series of EMPs to mitigate the effects of the Approved Project on the environment. These plans will be updated and implemented as appropriate to apply to the proposed modifications.

As a priority mitigation measure, AMNS has designed the WRSA expansion, new Clay Borrow Area, and Plant Access Road to avoid fish habitat. Where potential interactions cannot be avoided, measures to mitigate and reduce adverse effects are proposed. The mitigation measures below are recommended in consideration of the environmental effects pathways and include standard proven mitigation measures for sediment and erosion control, incorporate DFO Measures to Protect Fish and Fish Habitat (DFO 2019b) and the standards and codes of practice (DFO 2021) and consider regulations and guidelines that govern fish and fish habitat protection.

In addition to the mitigation described in Section 3, the following mitigation measures are recommended for fish and fish habitat:

- No work is to be done within 30 m of a watercourse or wetland, or within 30 m of the property boundaries without the necessary permits.
- The limits for approved clearing, grubbing and topsoil overburden removal will be clearly identified (flagging/survey stakes) in the field prior to the commencement of any work.
- Areas to be cleared will have sediment and erosion control measures implemented prior to the initiation of any clearing activities. The sediment and erosion control measures will be adapted to suit the field conditions associated with the specific construction activities as construction proceeds.
- Work operation will be conducted at a time and in a manner to protect watercourses from siltation and disturbance. Sediment control measures will be installed prior to construction and properly maintained until erodible material is stabilized.
- Refueling will not occur within 30 m of a watercourse or waterbody
- Work will l be performed in such a way as to prevent materials such as sediment, fuel or any other hazardous materials do not enter watercourses and waterbodies through the implementation of sediment control measures and proper hazardous materials management practices. In the event of a release to the environment, it will be immediately reported to the Environment Department and the Emergency Response Plan and Spill Contingency Plan will be implemented.
- The duration of work below the ordinary high-water mark will be planned to respect the DFO timing windows, as required.
- Work will be scheduled to avoid high precipitation and runoff events or periods that could increase the potential for erosion and sedimentation.
- No debris or other construction material will be allowed to enter watercourses
- Fish screens and/or other barriers will be installed and maintained to prevent fish from entering the in-pit disposal area, as is practically feasible.
- If explosives are required, use of explosives will follow DFO blasting guidelines (Wright and Hopky 1998)
- Water management infrastructure will be used to maintain flows and will be located as far upstream as is practically feasible.
- Water will be discharged via subsurface discharges on water management ponds which flow into fish-bearing waters.
- Effluent will be treated as required to applicable regulatory limits prior to discharge

8.7 ASSESSMENT OF RESIDUAL EFFECTS

8.7.1 Change in Fish Habitat Quantity

Prior to mitigation, the Project was anticipated to result in changes in streamflow to Watercourse #4 of 8.3% to the upper catchment and 2.8% in the total catchment as a result of water management associated with the WRSA expansion and new Clay Borrow Area. The changes in hydrology as a result of the Project were compared to the federal "Framework for Assessing the Ecological Flow Requirements to Support Fisheries in Canada" (DFO 2013) to determine potential residual effects to fish and fish habitat as a result of reductions in stream flow.

Following the guidance in DFO (2013), to avoid a cumulative indirect loss in flow as a result of changes in watershed area and diversion of site contact water from the WRSA and the new Clay Borrow Area, Watercourse #4 will be supplemented with flow from a newly constructed water management pond so that there is no loss of water quantity to Watercourse #4 from the existing condition. The outflow of the water management pond will be located near the transition zone between intermittent and perennial flow in Watercourse #4. The location of the pond is in the upper portion of the watershed where reductions in flow are anticipated in the absence of mitigation (i.e., water management pond). The water management pond will attenuate peak discharges to Watercourse #4. With mitigation, changes in flow are not anticipated to result in adverse effects to fish habitat quantity.

Connecting the engineered spillway to Watercourse #4 may result in a very small area of direct loss of fish habitat below the ordinary high-water mark. The total area for the spillway is anticipated to be less than 20 m^2. Work will be conducted during the low flow period to avoid in-water work to the extent practically feasible. The interactions for fish habitat are well known and documented and DFO Measures to Protect Fish and Fish Habitat (DFO 2019b) and standards and codes of practice (DFO 2021) will be followed to avoid residual effects to fish habitat.

The changes in watershed area or discharges associated with flows in other watercourses and waterbodies within the LAA were below the level where detectable changes to the ecosystem could be measured and are therefore not considered to result in adverse effects to fish habitat quantity.

Alterations to the water balance of Scraggy Lake during the existing mine TMF closure and continued operation and filling of the Open Pit as a result of the Project were below the level where detectable changes to the ecosystem could be measured and were therefore not considered to result in adverse effects to fish habitat quantity. Water withdrawals from Scraggy Lake during operation will be within the existing permitted amounts.

With careful Project planning, design and mitigation, a significant residual environmental effect on fish habitat quantity is not anticipated, because changes to the productivity or sustainability of fish populations within the LAA are not expected to occur.

8.7.2 Change in Fish Habitat Quality

The mitigation measures outlined in the EMPs for the Project (Section 3.0) will be employed to reduce the potential for residual effects where avoidance is not practically feasible during the construction of the engineered discharge from the water management pond to Watercourse #4. When working near water, the interactions for fish habitat are well known and documented and DFO Measures to Protect Fish and Fish Habitat (DFO 2019b) and standards and codes of practice (DFO 2021) will be followed. Residual effects to fish habitat quality are not anticipated following implementation of the DFO Measures to Protect Fish and Fish Habitat and standards and codes of practice.

The assessment of Project related effects on fish habitat quality as a result of treated effluent and seepage from the Project being released into the aquatic environment is dependent on the results of the assimilative capacity modeling completed in support of the Surface Water VC (Section 7.0). Some of the metals (i.e., aluminum, arsenic, and iron) are already elevated above the CWQG-FAL or NS Tier 1 EQS as a baseline condition in the receiving watercourses (i.e., Watercourse #4, upper Fish River, Moose River), and therefore the assimilative capacity of watercourses to receive seepage or discharge is limited for these parameters.

There is the potential for changes in fish habitat as a result of changes in surface water from groundwater seepage associated with the WRSA expansion. Changes in surface water quality above CWQG-FAL, NS Tier 1 EQS or baseline concentrations as a result of seepage from the WRSA expansion are not anticipated in upper Fish River and within the Ship Harbour Wilderness Area (Surface Water, Section 7.0) and are not anticipated to compromise the quality of fish habitat such that the productivity or sustainability of fish populations within the LAA are adversely affected, where recovery to baseline is unlikely.

Changes in water quality associated with the discharge of effluent containing COPC above the CWQG FAL into Moose River from the Open Pit tailings disposal and Watercourse #4 from the new water management pond could result in a change in fish habitat quality. Water-based discharges to these watercourses will be managed and treated to meet MDMER authorized limits or site-specific guidelines prior to discharge and closure. If COPC meet the CWQG-FAL, NS Tier 1 EQS, baseline concentrations or SSWQO at the discharge point, or within a short mixing zone in the receiving environment (i.e., 120 m downstream) then effects to fish habitat are not expected and if they occur will be localized to the mixing zone (Surface Water, Section 7.0).

With regards to the outflow from the new water management pond, the capacity of Watercourse #4 to assimilate aluminum, arsenic, and iron is limited because these parameters are elevated above the CWQG-FAL and cadmium is elevated above NSECC Tier 1 EQS as a baseline and existing condition. Modelling (described in Section 7.0) suggests that major ions are expected to increase following discharge, where metals concentrations remain relatively close to existing concentrations and will meet the NS Tier 1 EQS, CWQG-FAL or be similar to existing or baseline conditions at the downstream extent of the mixing zone in the receiving environment. After flow is returned to Watercourse #4 from the WRSA, nitrate concentrations are predicted to increase in the watercourse for a period of time. A vegetated cover will be established on the WRSA to limit nitrate concentrations from surface flow. The increase in nutrients may result in increased growth of algae and aquatic vegetation within the receiving environment. For context the concentrations are approximately an order of magnitude lower than those associated with agricultural landscapes (CCME 2012). Given that the maximum elevated predicted concentrations would be anticipated to be temporary and that the predicted nitrate concentration is anticipated to be below the CWQG-FAL a substantial change in fish habitat quality is not anticipated.

As described in the Surface Water VC assessment (Section 7.0), there is the potential for changes in fish habitat in Moose River as a result of changes in surface water from groundwater seepage associated with the in-pit tailings disposal area as the water level rises above the shallow bedrock and as a result of discharge of effluent from the in-pit disposal area via the engineered spillway. With regards to the discharge from the in-pit disposal area during reclamation and closure, the capacity of Moose River to assimilate aluminum, arsenic and iron is limited because these parameters are already above the CWQG-FAL as a baseline condition. Assimilative capacity modelling (Stantec 2021d; Appendix D.5) suggests that water quality will meet the CWQG-FAL or baseline at the end of the 120 m mixing zone within Moose

River, with the exception of arsenic which will be below the SSWQO for arsenic (30 ug/L). Given that COPC are below guidelines or site-specific objectives at the extent of the mixing zone, no measurable effects at the downstream extent of the LAA and RAA or within the Ship Harbour Wilderness Area are anticipated.

Release of treated effluent from the in-pit disposal area and the new water management pond have the potential to be warmer than the receiving waters due to the lacustrine nature of the ponded water. Given the depth, surface area and groundwater infiltration associated with the in-pit disposal area, water temperatures of effluent discharging from the in-pit disposal area are anticipated to be similar to the water temperatures in Square Lake near the outflow (i.e., SW-12; Stantec 2019b, 2020c, 2021f) given the size and groundwater inputs to the lake. Given that the temperature of effluent is anticipated to be similar or lower than those recorded in Square Lake, no substantive changes in habitat quality in Moose River as a result of changes in temperature are anticipated. Regarding the water management pond, changes in water temperature will be mitigated through subsurface discharge of cooler water from the bottom of the water management pond into Watercourse #4.

Changes in water quality associated with the discharge of effluent containing COPC could result in a change in fish habitat quality though changes in sediment quality. Given that metals will meet the CWQG-FAL, NSECC Tier 1 EQS, baseline concentrations or SSWQO by the end of the mixing zone, effects to sediment quality are not expected.

Adaptive management, including additional monitoring or mitigation, may be implemented as required based on the results of water quality monitoring in the receiving environment. Potential effects to fish and fish habitat will be assessed by EEM programs as required under MDMER.

Given that an indirect loss of fish habitat quantity is not anticipated (Section 8.7.1), no substantive changes in fish habitat quality as a result of reductions in water velocity or depth are expected.

With careful Project planning, design and mitigation, a significant residual environmental effect on fish habitat quality is not anticipated because changes to the productivity or sustainability of fish populations within the LAA where recovery to baseline is unlikely, are not anticipated.

8.7.3 Change in Fish Health and Survival

During construction of the engineered spillway, the mitigation measures outlined in Section 7.6 will be employed to reduce the potential for residual effects where avoidance is not feasible when working near water. The implementation of standards and codes of practice in accordance with DFO *Measures to Protect Fish and Fish Habitat* (DFO 2019b) will reduce residual effects to fish health and survival.

Stranding of fish as a result of the Project is unlikely as flows will be maintained within the areas of perennial flow and mimic the timing, duration, and frequency of natural flows to the extent feasible though the water management pond.

Changes in water quality associated with the discharge of effluent containing COPC above the CWQG FAL into watercourses (i.e., Moose River and Watercourse #4) could result in a change in fish health and survival though the uptake of metals or other pathological effects (i.e., gill damage). Effluent discharges are not expected to result in direct mortality of fish because effluent will be managed and treated to meet authorized limits prior to discharge. If parameters in the effluent meet CWQG-FAL at the discharge point, or within a short distance in the receiving environment then sublethal effects to fish are not expected, and if they occur will be localized to the mixing zone. If water quality parameters are above CWQG FAL but within baseline or site-specific guidelines, there is the potential for sublethal effects to fish, however these are unlikely to result in changes in the existing productivity or sustainability of fish populations within the LAA. Without treatment, at the downstream extent of the mixing zone, there is the potential for elevated concentrations of nitrate, which is considerably less toxic than nitrite or ammonia. Given that the maximum elevated predicted concentrations would be anticipated to be temporary and that predicted average nitrate concentrations are anticipated to be below the CWQG-FAL a substantial change in fish health and survival is not anticipated. AMNS is committed to meeting CWQG FAL, baseline or site-specific guidelines at the downstream extent of the mixing zone. Adaptive management, including additional monitoring or mitigation, may be implemented as required based on the results of the water quality monitoring. Potential effects to fish and fish habitat will be assessed by EEM programs as required under MDMER for final discharges.

During operation and reclamation and decommissioning of the in-pit tailings disposal area, release of treated effluent from the in-pit disposal area or water management pond has the potential to be warmer than the receiving waters due to the lacustrine nature of the ponded water. Given that no substantive changes in water temperature are anticipated within the receiving environments, no sublethal or acute effects to fish health are anticipated.

With careful Project planning, design and mitigation and environmental protection measures, a significant residual environmental effect on fish health and survival is not anticipated because changes to the productivity or sustainability of fish populations within the LAA are not anticipated.

8.8 FOLLOW-UP AND MONITORING

Follow-up monitoring for surface water quality and quantity will be completed as described in the Surface Water VC (Section 7.0). Follow-up monitoring associated with the release of treated effluent from the in-pit disposal area and water management pond will be conducted in accordance with MDMER, if and as required. Monitoring will include comparisons of water temperature at locations upstream, within and downstream of engineered drainage channels when effluent is being released.

9.0 TERRESTRIAL ENVIRONMENT

The terrestrial environment VC is defined as ecosystem upland and wetland habitats, associated vegetation communities, and the wildlife community that utilizes these habitats, including all terrestrial SAR and species of conservation interest (SOCI). The terrestrial environment was chosen as a VC because ecosystem habitats, vegetation communities and the fauna species that rely on these communities, may be altered, either directly or indirectly, by proposed Project activities.

Additionally, wildlife is protected under several provincial and federal pieces of legislation including the *Nova Scotia Wildlife Act* and the *Migratory Bird Convention Act*, and SAR are protected under federal and provincial Species at Risk legislation.

9.1 POTENTIAL EFFECTS, PATHWAYS AND MEASURABLE PARAMETERS

Table 9.1 lists the potential Project effects on the terrestrial environment and provides a summary of the Project effect pathways and measurable parameters to assess potential effects. Potential environmental effects and measurable parameters were selected based on review of recent EAs or similar projects in Nova Scotia and other parts of Canada, and professional judgment.

Table 9.1 Potential Effects, Effects Pathways and Measurable Parameters for the Terrestrial Environment

Potential Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Vegetation and Vegetation Communities including Priority Species	• Direct loss of habitat and vegetation due to increased footprint • Indirect impact to habitat and vegetation from dust and edge effects • Potential introduction of invasive and exotic species	• Area (ha) of habitat loss • Area (ha) of vegetation loss • Proximity of rare plants and lichens to edge of disturbance
Change in Wetland Habitat	• Direct loss or alteration of wetland area or function • Indirect loss of area/function due to hydrological changes • Indirect impact from changed water quality	• Area (ha) of type of wetland • Changed hydrology of wetland
Change in Wildlife including Priority Species	• Direct or indirect loss of habitat through expanded footprint and sensory disturbance • Mortality risk due to vehicle collisions or human-wildlife interactions • Attraction to site • Entrainment in Open Pit (or birds landing in Open Pit t)	• Area (ha) of wildlife habitat directly or indirectly lost or altered • Traffic volumes • Likelihood of interaction with Project infrastructure, personnel, vehicles, and equipment

9.2 BOUNDARIES

9.2.1 Spatial Boundaries

The following spatial boundaries were used to assess Project effects, including residual environmental effects, on the terrestrial environment in areas surrounding the WRSA expansion, new Clay Borrow Area, Plant Access Road, and in-pit tails deposition.

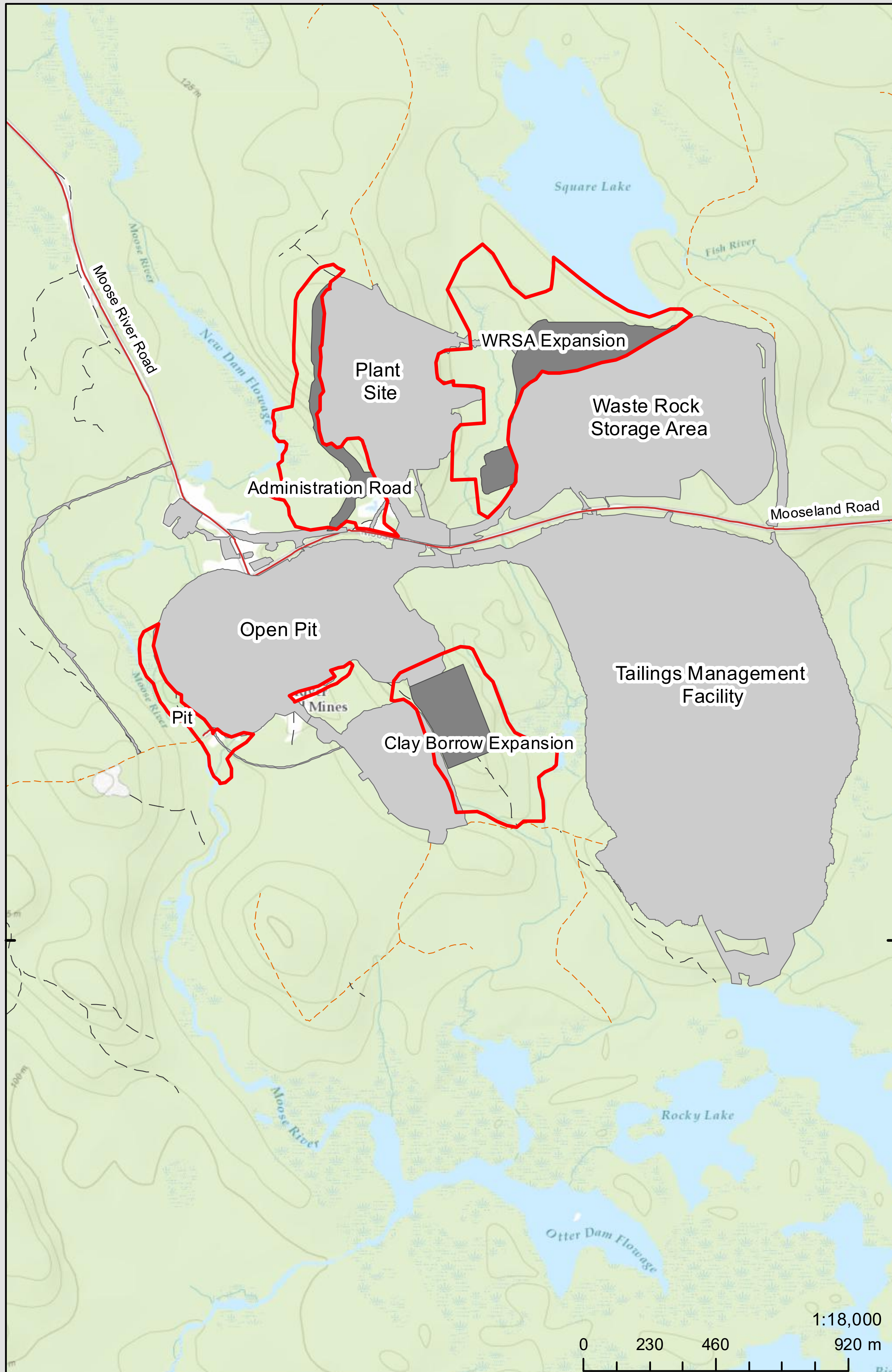
Project Development Area (PDA): The PDA encompasses the project footprint and is the anticipated area of direct physical disturbance associated with the construction, operation and decommissioning of the Project. It comprises the existing Open Pit, the WRSA Expansion Area, the new Clay Borrow Area, the RoWof the new Plant Access Road, and the area required for ancillary features associated with these Project components (e.g., ditching, monitoring wells, parking lot security guard house).

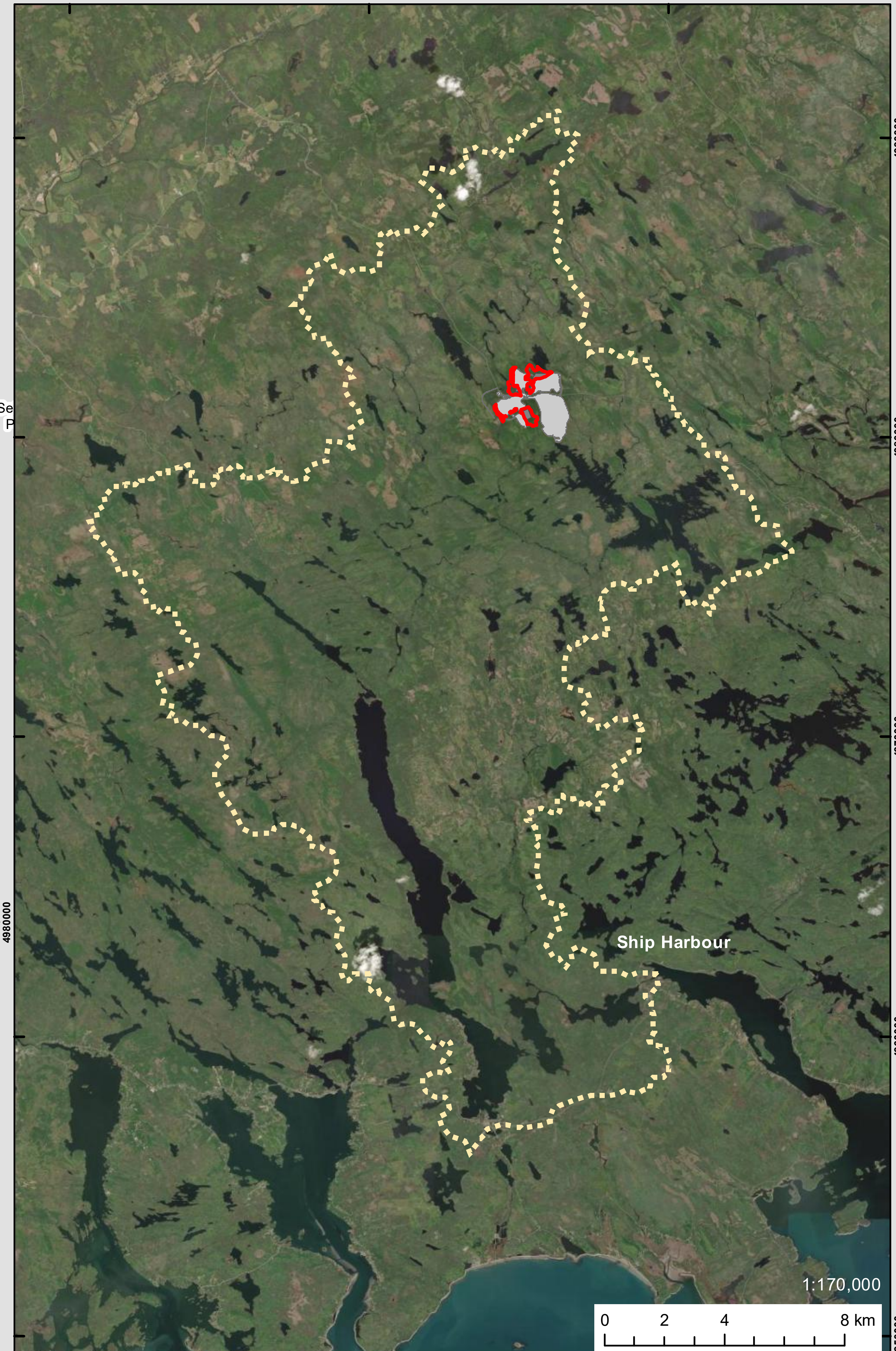
Local Assessment Area (LAA): The LAA (Figure 9.1) is the area in which both: a) project-related effects (direct or indirect) can be predicted or measured with a level of confidence that allows for assessment; and b) there is a reasonable expectation that those potential effects in the LAA will be an issue of public interest. The LAA encompasses the PDA and is VC specific.

For the purposes of the terrestrial environment, the LAA has been defined for each portion of the PDA based on expected maximum indirect impact to ecosystem habitats, vegetation communities and fauna, specifically from predicted edge effect and/or dust, and also based on the maximum indirect impact to wetland habitat from surface water management of mine contact water which may affect the hydrology of nearby wetlands.

Regional Assessment Area (RAA): The RAA is the area that establishes the context for determining significance of project-specific effects. It is also the area within which potential cumulative effects—the residual effects from the project in combination with those of past, present, and reasonably foreseeable projects—are assessed. The RAA encompasses the PDA and the LAA. The RAA is larger than the LAA to provide the needed larger context for the assessment of project-specific effects. However, the size of the RAA is a factor in the legitimacy of the assessment (e.g., we should be sensitive to the dilution of the projects effect as RAA size increases, which might not be defensible).

The RAA incorporates the PDA and LAA and encompasses the entirety of the Fish River-Lake Charlotte watershed (IEL-5) which includes Moose River, lower Fish River, Scraggy Lake and Lake Charlotte (Figure 9.1).





Prepared For:

Atlantic Gold

FIGURE 9.1

Touquoy Gold Project

2021 EARD

Infrastructure and Spatial Boundaries

RAA (Fish River-Lake Charlotte Watershed)
LAA (Indirect Impact Extent)
PDA (Direct Impact Extent)
Touquoy Mine Site Existing Footprint

Roads

Local
Dry Weather / Seasonal
Track

Coordinate System: NAD 1983 CSRS UTM Zone 20N
Projection: Transverse Mercator
Datum: North American 1983 CSRS
Units: Meter

Scale when printed @ 11" x 17"
Drawn By: SS
Reviewed By: MM
Date: 2021-06-25

McCallum Environmental Ltd.

Document Name: 210602_TQ EA_Spatial Boundaries

9.2.2 Temporal Boundaries

The temporal boundaries for the assessment of effects on the terrestrial environment include the construction phase, operation phase, and closure phase, which includes the decommissioning and reclamation stage, and post-closure stage; the project schedule is provided in Section 2.5.

9.3 SIGNIFICANCE DEFINITION

For the purposes of this EARD, a significant adverse residual environmental effect on the terrestrial environment is defined as a measurable Project-related environmental effect that results in:

- a permanent, unmitigated, uncompensated loss of habitat and the distribution of supported flora and wildlife species, relative to existing baseline conditions

An adverse effect that does not cause a permanent alteration to habitat, species distribution or the direct loss of SAR is not considered to be significant. The magnitude of a predicted change in the terrestrial environment is based on the direct loss of habitat and habitat which supports priority species in consideration of regional habitat availability, quality of lost habitat and mitigation (e.g., reclamation).

9.4 BASELINE CONDITIONS

9.4.1 Pre-Development Conditions

The following sections summarize the pre-development conditions found within the Touquoy Mine Site, as described in detail in the 2007 EARD for the Touquoy Gold Project (CRA 2007a).

9.4.1.1 Habitat and Vegetation

Vegetation Community Types

The habitat condition at the location of the proposed Plant Access Road was described as a mixture of softwood, mixed-wood and hardwood stands (CRA 2007a). The WRSA expansion LAA was described as a hardwood stand with recent harvesting activities, and the Clay Borrow Area expansion LAA was described as a mixed wood and hardwood stand (CRA 2007a).

Field surveys completed to support the 2007 EARD (CRA 2007a) described softwood habitat as areas dominated by Red Spruce (*Picea rubens*) and Balsam Fir (*Abies balsamea*), and mixed-wood habitat similar vegetation with the addition of Red Maple (*Acer rubrum*) and White Birch (*Betula papyrifera).* Hardwood habitat was recorded to be dominated by Red Maple, White Birch and Large-toothed Aspen (*Populus grandidentata*). Recent harvest areas were found to be dominated by shrub species such as Black Spruce (*Picea mariana*), Low-bush Blueberry (*Vaccinium myrtilloides*) and brambles (*Rubus spp.*).

Vascular Flora

A desktop review completed to support the 2007 EARD (CRA 2007a) found that 20 species, listed at the time as rare by the NSDNR, had potential suitable habitat within the overall Touquoy Mine Site, and had records within 100 km of the site. These records were pulled from two sources, the 2005 AC CDC report, and the 2004 Nova Scotia Museum environmental screening.

Table 9.2 provides the NSDNR 2007 rankings (Green, Yellow, Red) and current status of the plants identified during the desktop review to have potential to occur within the LAA. None of the plants presented were, in 2007, listed under the *Nova Scotia Endangered Species Act* (NSESA), COSEWIC or the *Species at Risk Act* (SARA). As of 2021, none of these plant species are currently listed under NSESA, COSEWIC or SARA. The current 2021 AC CDC ranks have been included in Table 9.2.

During field dedicated vegetation surveys completed between 2004 to 2006 to support the EARD, none of the listed plant species in Table 9.2 were observed.

Table 9.2 Priority Vascular Plants Listed in the 2007 EARD with Current 2021 Status

Scientific Name	Common Name	NSDNR Status (2007)	2021 Status (COSEWIC, NSESA, SARA)	2021 AC CDC Status
Betula michauxii	Michaux's dwarf birch	Yellow	Not Listed	S2S3
Coeloglossum viride	Long-bract frog orchid	Yellow	Not Listed	S2S3
Epilobium coloratum	Purple-veined willow herb	Yellow	Not Listed	S2?
Goodyera pubescens	Downy rattlesnake plantain	Red	Not Listed	S2
Iris prismatica	Slender blue flag	Red	Not Listed	S1
Listera australis	Southern twayblade	Red	Not Listed	S3
Malaxis monophyllos	White adder's-mouth	Red	Not Listed	S1
Bidens beckii	Water beggarticks	Yellow	Not Listed	S3
Dichanthelium linearifolium	Narrow-leaved Panicgrass	Yellow	Not Listed	S3
Platanthaera flava	Southern rein orchid	Yellow	Not Listed	S2
Proserpinaca pectinata	Comb-leaved mermaidweed	Yellow	Not Listed	S3
Salix pedicellaris	Bog willow	Yellow	Not Listed	S2
Salix sericea	Silky willow	Yellow	Not Listed	S2
Spiranthes ochroleuca	Yellow ladies' tresses	Yellow	Not Listed	S3
Utricularia gibba	Humped bladderwort	Yellow	Not Listed	S4
Vaccinium caespoitosum	Dwarf bilberry	Yellow	Not Listed	S3
Vaccinium uliginosum	Alpine bilberry	Yellow	Not Listed	S3

Table 9.2 Priority Vascular Plants Listed in the 2007 EARD with Current 2021 Status

Scientific Name	Common Name	NSDNR Status (2007)	2021 Status (COSEWIC, NSESA, SARA)	2021 AC CDC Status
Viola nephrophylla	Northern bog violet	Yellow	Not Listed	S2
Zizia aurea	Golden alexanders	Yellow	Not Listed	S1

Lichens

The Touquoy Mine Site project site was surveyed for lichens in 2004 and 2005 in support of the EARD (CRA 2007a). Twenty-one lichen species were recorded across the site and are provided in Table 9.3 (Figure 9.4 of CRA 2007a). Of these 21 species, only Blue Felt Lichen (*Pectenia plumbea*) is currently listed as Special Concern (COSEWIC and SARA) and Vulnerable (NSESA). As of 2021, no new lichen species presented in Table 9.3 are listed under NSESA, COSEWIC or SARA. The current 2021 AC CDC ranks have been included in Table 9.3.

Table 9.3 Lichen Species Observations during 2007 Lichen Survey

Scientific Name	DRAFT NSDNR Status (2007)	2021 Status (COSEWIC, NSESA, SARA)	2021 AC CDC Status
Coccocarpia palmicola	Yellow	Not listed	S3S4
Collema subflaccidum	Green	Not listed	S5
Pectenia plumbea	Yellow	Special Concern (COSEWIC/SARA) Vulnerable (NSESA)	S3
Fuscopannaria ahlneri	Red	Not listed	S3
Heterodermia obscurata	N/A	Not listed	SNA
Heterodermia speciosa	N/A	Not listed	S3
Imshaugia placorodia	N/A	Not listed	S4S5
Leptogium corticola	Yellow	Not listed	S3
Leptogium cyanescens	Green	Not listed	S5
Leptogium laceroides	Yellow	Not listed	S4
Lobaria pulmonaria	Green	Not listed	S5
Lobaria quercizans	Green	Not listed	S5
Lobaria scrobiculata	Green	Not listed	S5
Moelleropsis nebulosa	Red	Not listed	S3
Nephroma bellum	Green	Not listed	S3
Pannaria conoplea	Yellow	Not listed	S4
Pannaria rubiginosa	Yellow	Not listed	S4
Parmeliella triptophylla	Green	Not listed	S5
Peltigera aphthosa	Green	Not listed	S5

Table 9.3 Lichen Species Observations during 2007 Lichen Survey

Scientific Name	DRAFT NSDNR Status (2007)	2021 Status (COSEWIC, NSESA, SARA)	2021 AC CDC Status
Pseudocyphellaria perpetua	Green	Not listed	SNA
Sticta fuliginosa	Yellow	Not listed	S3

As shown in Figure 9.4 of CRA (2007a), the 2004 and 2005 surveys recorded three occurrences of blue felt lichen, one west of the proposed Clay Borrow Area expansion in Wetland 27, one west of the WRSA in Wetland 15 and one in Wetland 40, beyond the 2007 EARD project area. Other lichen observations were primarily clustered southwest of the Clay Borrow Area, along the western side of Watercourse 4 within Wetland 15 or under the current TMF (SD 14).

9.4.1.2 Wetlands

A total of six wetlands were evaluated in the 2007 EARD (CRA 2007a). In 2015 and 2016 an additional 33 wetlands were identified across the entire Touquoy Mine Site to support the wetland alteration permitting process. Twelve wetlands, identified in either 2007 or as part of the 2015 and 2016 survey efforts, exist partially or fully within LAA associated with this EARD (Figure 9.2).

The following wetlands, identified as part of the 2015 and 2016 surveys, exist within the LAA associated with this EARD. Additional wetlands within the study areas identified as part of the 2021 EARD biophysical assessment process are presented in Section 9.4.2.

- Wetlands 6, 28 and 35 are within the Clay Borrow Area expansion LAA
- Wetlands 15 and 17 are within the WRSA expansion LAA
- Wetlands 22, 25, 27, 40 and 49 are within the Open Pit LAA
- Wetlands 32 and 29 are within the Plant Access Road LAA

The following sections provide biophysical information obtained in 2015 and 2016 for the 12 wetlands listed above. Information on Wetlands 6, 15, 17, 22, 25, 27, 28, 29 and 32 was initially collected to support provincial permitting for wetland alteration and was provided to NSECC in the following two documents:

- "Wetland and Watercourse Evaluation, Touquoy Mine/Moose River Consolidated Gold Project/Moose River Gold Mines, Nova Scotia (February 05, 2016)"
- "Wetland and Watercourse Alteration Application, Touquoy Mine/Moose River Consolidated Gold Project/Moose River Gold Mines, Nova Scotia (March 11, 2016)"

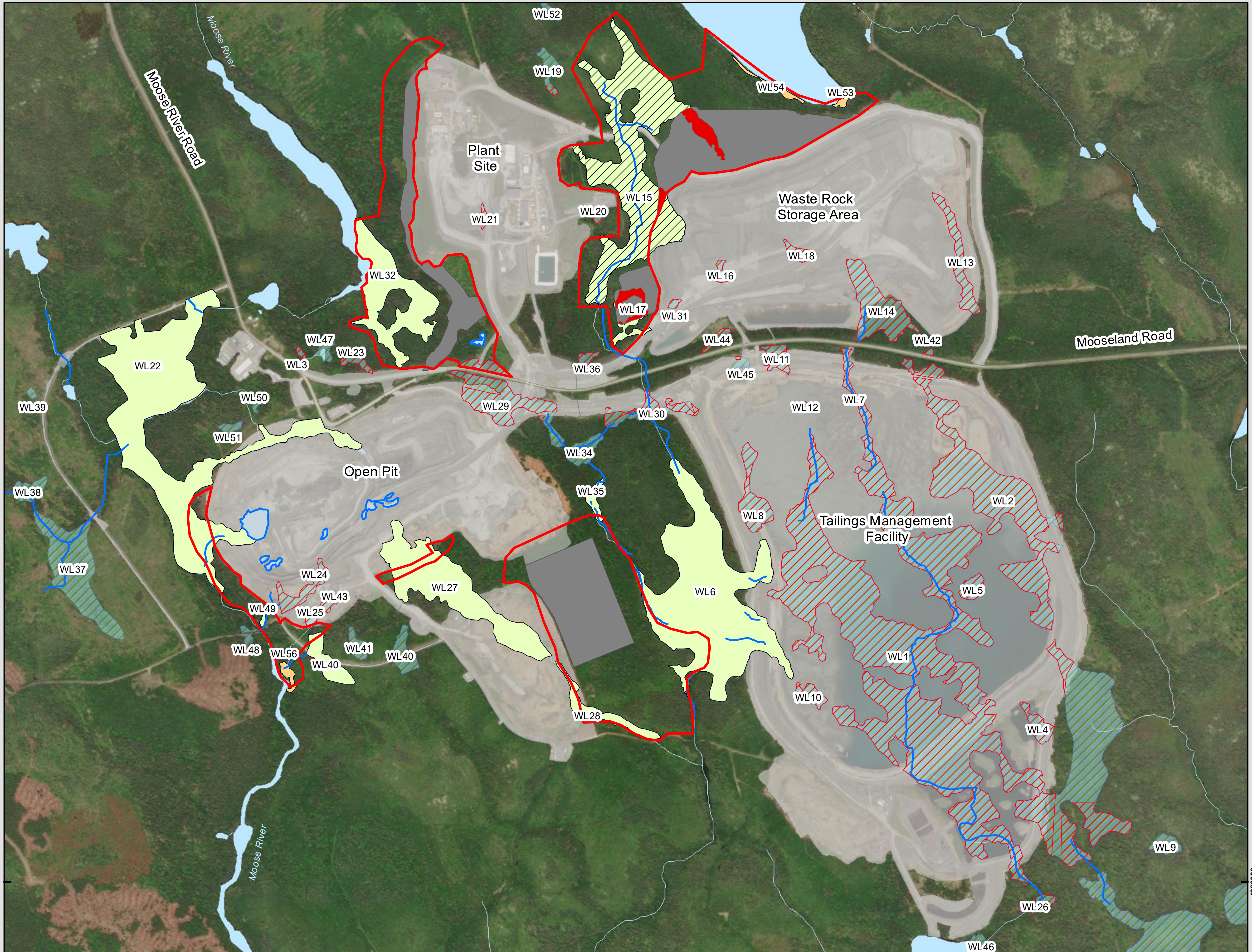
Wetland 40 was assessed, and biophysical information was collected in March and June 2016 as part of the permitting process associated with construction of the bypass road. This information was presented in the following document:

- "Wetland Alteration Application – Western Diversion Road, Touquoy Mine/Moose River Consolidated Gold Project/Moose River Gold Mines, Nova Scotia (July 11, 2016)"

Wetlands 35 and 49 were identified and assessed in the field during snow free conditions in February and March 2016, respectively.

Biophysical information pertaining to Wetlands 53, 54 and 56 was collected in 2019 and 2021 in support of the potential WRSA expansion and expanded Moose River effects assessment and are discussed further in Section 9.4.2.3.

Table 9.4 presents characteristics for all wetlands identified and assessed in 2015 and 2016 within the LAA. Wetland functional assessments were completed using the Nova Scotia Wetland Assessment Method (NOVA WET Version 3.0 September 2011). Table 9.5 provides an overview of functional assessments performed in these wetlands. Wetlands identified within the four LAA are shown on Figure 9.2.



Prepared For:

Atlantic Gold

FIGURE 9.2

Touquoy Gold Project

2021 EARD

Wetlands and Direct Impacts within the LAAs

Field Delineated Watercourse
NSECC Mapped Watercrouse
Waterbody
Field Delineated Wetland
Approved Wetland Alteration

2021 EARD Wetlands

Pre-development Baseline (2015/2016)
Existing Baseline (post 2016)
Confirmed WSS
2021 EARD Wetland Direct Impact
LAA (Indirect Impact Extent)
PDA (Direct Impact Extent)
Touquoy Mine Site Existing Footprint

Coordinate System: NAD 1983 CSRS UTM Zone 20N
Projection: Transverse Mercator
Datum: North American 1983 CSRS
Units: Meter

0 125 250 500 m

1:10,000 Scale when printed @ 11" x 17"

Drawn By: SS
Reviewed By: MM
Date: 2021-06-25

McCallum Environmental Ltd.

Document Name: 210602_TQ EA_Wetlands

Table 9.4 Baseline (2015/2016) Wetland Characteristics Overview

WETLAND ID	WETLAND TYPE	HYDRIC SOIL TYPE	SURFACE HYDROLOGY	WETLAND BOUNDARY/BUFFER	DOMINANT VEGETATION	WATER INFLOW/ OUTFLOW
CLAY BORROW AREA EXPANSION LAA						
WL6.1	Lotic Stream Confined, Throughflow Coniferous treed swamp	1. Low-Highly decomposed organic 2. A1 Histosol and A4 Hydrogen Sulphide	1. High water table 2. Saturation 3. Water-stained leaves 4. Moss trim lines 5. Dry-season water table 6. Geomorphic position 7. Microtopographical relief	High (15%), moderate (35%) and low (50%) slope natural buffer >100m	Herbs Osmunda cinnamomea Shrubs Abies balsamea; Alnus incana, Picea mariana Trees Picea mariana; Larix laricina	Water draining into western extent of wetland via unnamed intermittent watercourse and sourced from WL29 and WL34. Watercourse # 4 drains through central portion of wetland (fen) and sourced by headwater WL15.
WL6.2	Lotic Stream Confined, Throughflow Tall shrub swamp	1. Highly decomposed organic 2. A1 Histosol and A4 Hydrogen Sulphide	1. Surface water 2. High water table 3. Saturation 4. 4) Water marks 5. Sparsely vegetated concave surface 6. Water-stained leaves 7. Hydrogen sulphide Secondary indicators: 8. Drainage patterns	High (15%), moderate (35%) and low (50%) slope natural buffer >100m	Herbs Carex stricta Shrubs Viburnum nudum Trees Larix laricina	
WL6.3	Lotic Stream Confined, Throughflow Low shrub fen	Rapid assessment (no soil pit); assumed organic, A1 Histosol	1. Surface water 2. Saturation 3. Water-stained leaves	High (15%), moderate (35%) and low (50%) slope natural buffer >100m	Herbs Chamaedaphne calyculata; Carex stricta Shrubs – None Trees – None	

Table 9.4 Baseline (2015/2016) Wetland Characteristics Overview

WETLAND ID	WETLAND TYPE	HYDRIC SOIL TYPE	SURFACE HYDROLOGY	WETLAND BOUNDARY/BUFFER	DOMINANT VEGETATION	WATER INFLOW/ OUTFLOW
WL28	Terrene, isolated, cleared treed swamp	1. Highly decomposed organic 2. >50cm depth 3. A1 Histosol and A4 Hydrogen sulphide	1. High water table 2. Saturation 3. Water marks 4. Water-stained leaves 5. Hydrogen sulphide Secondary indicators: 6. Drainage patterns 7. Geomorphic position	Moderate (100%) slope natural buffer >50m	Herbs Rubus hispidus, Oclemena nemoralis, Carex trisperma Shrubs Abies balsamea, Larix laricina Trees Larix laricina	Water provided by passive overland drainage from northeast and southwest of the wetland.
WL35	Terrene, throughflow (via drainage) mixed wood swamp	1. A1 HistosoL 2. 15cm depth upon rock.	1. High water table 2. Saturation 3. Drainage patterns 4. Water-stained leaves	Moderate (100%) slope natural buffer >100m	Herbs Osmunda cinnamomea Shrubs Abies balsamea Trees Abies balsamea Acer rubrum	Drainage flow from upstream WL34 and WL29 provide a water source.

Table 9.4 Baseline (2015/2016) Wetland Characteristics Overview

WETLAND ID	WETLAND TYPE	HYDRIC SOIL TYPE	SURFACE HYDROLOGY	WETLAND BOUNDARY/BUFFER	DOMINANT VEGETATION	WATER INFLOW/ OUTFLOW
WRSA EXPANSION LAA						
WL15.1	Outflow – headwater, lotic confined treed swamp	1. Low-High decomposition organic 2. >40cm depth 3. A1 Histosol	1. High water table 2. Saturation 3. Moss trim lines 4. Dry-season water table 5. Geomorphic position	High (10%), moderate (50%) and low (30%) slope natural buffer >50m	Herbs Lonicera villosa Shrubs Picea mariana, Viburnum nudum Trees Picea mariana	Water sourced by drainage inlet to the north of the wetland and passive overland drainage form adjacent uplands to the east and west. Outlet watercourse (identified by MEL as Watercourse #4) drains southward towards WL30 and WL6
WL15.2	Outflow – headwater, lotic confined treed swamp	1. High decomposition organic 2. >50cm depth 3. A1 Histosol and A4 Hydrogen sulphide	1. High water table 2. Saturation 3. Water-stained leaves 4. Hydrogen sulphide	High (10%), moderate (50%) and low (30%) slope natural buffer >50m	Herbs Onoclea sensibilis, Rubus hispidus Shrubs Abies balsamea; Alnus incana Trees Abies balsamea; Acer rubrum, Picea mariana	
WL15.3	Outflow – headwater, lotic confined tall shrub swamp	1. Moderately decomposed organic over rock 2. 15 cm depth 3. A1 Histosol	1. High water table 2. Saturation 3. Water-stained leaves	High (10%), moderate (50%) and low (30%) slope natural buffer >50m	Herbs Osmunda cinnamomea; Thelypteris noveboracensis; Dryopteris cristata Shrubs Alnus incana, Abies balsamea Trees Acer rubrum	

Table 9.4 Baseline (2015/2016) Wetland Characteristics Overview

WETLAND ID	WETLAND TYPE	HYDRIC SOIL TYPE	SURFACE HYDROLOGY	WETLAND BOUNDARY/BUFFER	DOMINANT VEGETATION	WATER INFLOW/ OUTFLOW
WL17.1	Terrene, isolated, sloped coniferous treed swamp	1. Moderately decomposed organic over rock 2. 26 cm depth 3. A1 Histosol	1. High water table 2. Saturation Secondary indicators: 3. Drainage patterns 4. Moss trim lines 5. Dry-season water table	Moderate (40%) and low (60%) slope natural buffer >50m	Herbs Cornus canadensis; Ledum groenlandicum Shrubs Picea mariana; Viburnum nudum; Nemopanthus mucronatus Trees Picea mariana	Water provided by passive overland drainage from adjacent uplands. Drainage outlet to the south towards Watercourse #3
WL17.2	Terrene, isolated, sloped coniferous treed swamp	1. Low-Highly decomposed organic over rock 2. 38 cm depth 3. A1 Histosol	1. High water table 2. Saturation Secondary indicators: 3. Drainage patterns 4. Moss trim lines 5. Dry-season water table	Moderate (40%) and low (60%) slope natural buffer >50m	***Herbs*** *Osmunda cinnamomea; Rubus hispidus* ***Shrubs*** *Abies balsamea* ***Trees*** *Abies balsamea*	

Table 9.4 Baseline (2015/2016) Wetland Characteristics Overview

WETLAND ID	WETLAND TYPE	HYDRIC SOIL TYPE	SURFACE HYDROLOGY	WETLAND BOUNDARY/BUFFER	DOMINANT VEGETATION	WATER INFLOW/ OUTFLOW
PLANT ACCESS LAA						
WL29	Outflow – headwater, terrene coniferous treed swamp	1. Highly decomposed organic over rock 2. 35cm depth 3. A1 Histosol and A4 Hydrogen sulphide	1. Surface water 2. High water table 3. Saturation 4. Sparsely vegetated concave surface 5. Water-stained leaves 6. Hydrogen sulphide Secondary indicators: 7. Drainage patterns 8. Geomorphic position	Moderate (20%) and low (80%) slope natural and roadside buffer 30m	Herbs Thelypteris simulate, Glyceria melicaria Shrubs Alnus incana, Larix laricina Trees Larix laricina; Picea mariana	Water provided by passive overland drainage from adjacent uplands. Outlet watercourse (identified by MEL as Watercourse #3) flows southeast to WL34.
WL32.1	Lotic (river) confined, throughflow coniferous treed swamp	1. Organic 2. >50cm depth 3. A1 Histosol and A4 Hydrogen sulphide	1. High water table 2. Saturation 3. Water-stained leaves 4. Hydrogen sulphide	High (20%), moderate (40%) and low (40%) slope natural buffer >100m	Herbs Osmunda cinnamomea, Carex trisperma Shrubs Abies balsamea Trees Picea mariana; Abies balsamea; Acer rubrum	Water provided by Moose River and adjacent upland to the northeast and south.
WL32.2	Lotic (river) confined, throughflow fen	1. Organic 2. >50cm depth 3. A1 Histosol and A4 Hydrogen sulphide	1. Surface water 2. High water table 3. Saturation 4. Water-stained leaves 5. Aquatic fauna 6. Hydrogen sulphide	High (20%), moderate (40%) and low (40%) slope natural buffer >100m	Herbs Sarracenia purpurea, Myrica gale Shrubs Alnus incana Trees Larix laricina	

Table 9.4 Baseline (2015/2016) Wetland Characteristics Overview

WETLAND ID	WETLAND TYPE	HYDRIC SOIL TYPE	SURFACE HYDROLOGY	WETLAND BOUNDARY/BUFFER	DOMINANT VEGETATION	WATER INFLOW/ OUTFLOW
OPEN PIT LAA						
WL22.1 (eastern extent/ Open Pit side)	Lotic (river) confined, throughflow tall shrub swamp	1. Decomposed organic – 3cm depth – over mineral fine loam/muck – 5cm depth 2. Restrictive layer is rock 3. A2 Histic epepidon and F3 Depleted matrix	1. Intermittent Surface water 2. High water table 3. Saturation 4. Water marks 5. Thin muck surface 6. Sparsely vegetated concave surface 7. Water-stained leaves 8. Drainage patterns 9. Geomorphic position 10. Microtopographical relief	High (10%), moderate (40%) and low (50%) slope natural, pit and road buffer 40m	Herbs Onoclea sensibilis Shrubs Alnus incana Trees Larix laricina	Former Watercourse #1 initiating from the former Open Pit provided a source of surface water. Potential bank overflow in Moose River. Potential groundwater discharge. No surface water outflow present.
WL25	Terrene, isolated, tall shrub swamp	Rapid assessment (no soil pit); assumed F3 Depleted matrix	1. Saturation 2. Water marks 3. Water-stained leaves 4. Standing water to a depth exceeding 50cm	Low (100%) slope natural buffer >50m	Herbs Onoclea sensibilis Shrubs Alnus incana Trees None	Water provided by passive overland drainage from adjacent upland.

Table 9.4 Baseline (2015/2016) Wetland Characteristics Overview

WETLAND ID	WETLAND TYPE	HYDRIC SOIL TYPE	SURFACE HYDROLOGY	WETLAND BOUNDARY/BUFFER	DOMINANT VEGETATION	WATER INFLOW/ OUTFLOW
WL27.1	Terrene, isolated, mixed-wood treed bog	1. Highly decomposed organic 2. >50cm depth 3. A1 Histosol and A4 Hydrogen sulphide	1. High water table 2. Saturation 3. Hydrogen sulphide	Moderate (30%) and low (70%) slope natural and roadside buffer 40m	Herbs Osmunda cinnamomea; Carex trisperma Shrubs Acer rubrum, Abies balsamea, Picea mariana Trees Acer rubrum	Water provided by passive overland drainage from adjacent upland particularly to the northeast. Water drains from wetland at southeastern extent via drainage into WL28.
WL27.2	Terrene, isolated, tall shrub swamp	1. Moderately decomposed organic over rock 2. 32 cm depth 3. A1 Histosol	1. Saturation 2. Water marks 3. Sparsely vegetated concave surface 4. Water-stained leaves 5. Drainage patterns 6. Geomorphic position	Moderate (30%) and low (70%) slope natural and roadside buffer 40m	Herbs Onoclea sensibilis, Fragaria virginiana Shrubs Alnus incana Trees None	
WL40	Terrene, outflow, tall shrub swamp/coniferous treed swamp complex	1. Organic (sapric) 2. 40 cm depth 3. A1 Histosol	1. Saturation 2. High water table 3. Water marks 4. Water-stained leaves 5. Intermittent standing water	Moderate (80%) and low (20%) slope natural buffer.	Herbs Osmunda cinnamomea; Carex trisperma Calamagrostis canadensis Shrubs Nemopanthus mucronatus Alnus incana Trees Picea mariana	Drainage feature inflow at north eastern lobe and surface water run-off or groundwater discharge. Ephemeral stream outflow identified at western boundary and drains toward Moose River.

Table 9.4 Baseline (2015/2016) Wetland Characteristics Overview

WETLAND ID	WETLAND TYPE	HYDRIC SOIL TYPE	SURFACE HYDROLOGY	WETLAND BOUNDARY/BUFFER	DOMINANT VEGETATION	WATER INFLOW/ OUTFLOW
WL49	Shrub swamp Terrene, throughflow	1. Organic (sapric) 2. 40 cm depth 3. A1 Histosol	1. Saturation 2. High water table 3. Water marks 4. Water-stained leaves 5. Intermittent standing water	Moderate (60%) and low (40%) slope natural buffer.	Herbs Onoclea sensibilis Shrubs Alnus incana	Intermittent watercourse throughflow

Table 9.5 Baseline (2015/2016) Wetland Functions Overview

Individual Function	Wetland Functions	WL 6	WL 28	WL 15	WL 17	WL 22	WL 27	WL 29	WL 32	WL 35	WL 40	WL 49
Adjacent Land Condition and Integrity	Extensive natural wetland buffer present (100m +) providing good water quality, erosion protection and wildlife habitat functions.	X	X		X				X	X	X	
	Extensive natural wetland buffer present (75m +) providing good water quality, erosion protection and wildlife habitat functions.			X						X		
	Width of vegetated buffer is moderately adequate for water quality and wildlife function, but only expands 30-40m.						X	X		X		
	Full vegetation cover in buffer comprising native, non-invasive species.	X	X		X				X	X		X
	The majority (80%) of the vegetative buffer is well vegetated and comprises native, non-invasive species. A portion of the vegetative buffer however is disturbed due to adjacent Mooseland Road.							X		X		X
	The majority (90%) of the vegetative buffer is well vegetated and comprises native, non invasive species. A portion of the vegetative buffer however lacks vegetation due to adjacent Plant Access Road and historical gold mining.						X				X	
	80% of the wetland buffer is at least 100m wide and provides good water quality, erosion protection and wildlife habitat functions. 20% of the buffer is less than 20m wide. 20% of the buffer comprises no vegetation due to historical pit.					X						
	Wetland buffers are sloped gently and provide good wildlife habitat.							X				X
	Wetland buffers are sloped moderately enough to provide wildlife habitat in most cases, but steeper areas exist at specific locations.			X		X			X		X	
	Wetland buffers are sloped moderately enough to provide good wildlife habitat.	X	X		X		X					

Table 9.5 Baseline (2015/2016) Wetland Functions Overview

Individual Function	Wetland Functions	WL 6	WL 28	WL 15	WL 17	WL 22	WL 27	WL 29	WL 32	WL 35	WL 40	WL 49
Hydrological Condition and Integrity	Wetland is located alongside a headwater stream so is important at managing baseflows/streamflows.	X		X				X				X
	Wetland provides an average ability to detain minor flood surface flows as a result of dense, rigid, non-woody vegetation and lack of surface channels.					X				X		
	Wetland has been bisected by construction of Mooseland Road (year unknown). Otherwise, soils lack evidence of previous disturbance. Hydrologic integrity is maintained.							X				
	Wetland is geographically isolated (comprises ephemeral drainage outlet), and therefore stores water sourced from surface run-off, precipitation, and groundwater discharge. In doing so, water does not drain directly into tributaries, and potential for downstream flood control is reduced (i.e increases groundwater recharge).		X		X		X				X	
	Wetland soils lacks evidence of previous disturbance.	X	X	X	X		X		X	x		x
	Adjacent upland soils are clay/bedrock; therefore, wetland provides good flood attenuation function.	X	X					X	X	x	X	x
	Wetland is unaltered so maintains is natural hydrologic regime.	X	X	X	X				X	x	X	x
	Wetland does not experience sediment delivery; therefore, water storage capacity is unaltered.	X	X	X	X	X		X	X	x	X	x
	Wetland comprises intermittent standing water and other surface water retention indicators. Therefore, it provides a **good** ability to detain surface water.		X	X	X			X	X	x	X	x
	Wetland comprises intermittent ponding water and multiple other surface water retention indicators. Therefore, its ability to detain surface water is **high**.	X								x		x
	Wetland is contiguous with a watercourse and comprises some small drainage channelization, therefore provides an average ability to retard flows, and reduce downstream flooding.			X						x		x

Table 9.5 Baseline (2015/2016) Wetland Functions Overview

Individual Function	Wetland Functions	WL 6	WL 28	WL 15	WL 17	WL 22	WL 27	WL 29	WL 32	WL 35	WL 40	WL 49
	Lack of surface channels present, therefore water flows through wetland via sheet flow and is hence retarded, subsequently reducing downstream flooding.		X		X		X	X			X	
Water Quality	Wetland and/or watercourses exhibiting fish resources exist within 1km of the wetland, therefore enhancing its water quality functions.	X	X	X	X	X	X	X	X	x	X	x
	Wetland type (lotic riparian) and position in the landscape allow surface run-off to be held and filtered prior to entering surface water.					X			X	x		x
	Wetland provides mechanism to manage nutrient loading from Mooseland Road (as evidenced by cattail growth along road).							X				
	Wetland comprises **significant** vegetative density valuable for decreasing water energy and allow settling of suspended materials.	X										
	Vegetative density is **moderate**, hence generating an **average** capacity to settle suspended sediments.		X	X	X	X	X	X			X	
	Wetland holds and filters surface water run-off considerably, prior to it entering a surface water feature.	X										
	Reported historic mine tailings in wetland, therefore water quality function as it relates to this is unknown.						X					

Table 9.5 Baseline (2015/2016) Wetland Functions Overview

Individual Function	Wetland Functions	WL 6	WL 28	WL 15	WL 17	WL 22	WL 27	WL 29	WL 32	WL 35	WL 40	WL 49
Shoreline Stabilization and Integrity	None. Wetland does not exist in association with a watercourse, lake, pond, estuary, ocean.		X		X		X					
	Wetland is contiguous with a watercourse which drains through additional wetland habitats downstream of the wetland.	X		X								
	Wetland is contiguous with a watercourse (Moose River) which drains through multiple wetlands and areas of open water.								X			
	Wetland is contiguous with Moose River and provides an average ability to provide shoreline erosion protection.					X						
	Shoreline/streambank vegetation condition upslope of watercourse is deep rooted and natural, therefore protecting the watercourse bank from erosive forces of water sourced from surface run-off. In stream and wetland vegetation, however, does not provide superior function in this regard.								X			
	Wetland acts as the source of water to the ephemeral watercourse. Therefore, it does not provide shoreline stabilization and integrity functions.							X				
	Watercourse comprises an average cover of rooted vegetation which helps dissipate flows.	X										
	Upstream vegetation is deep rooted and natural, therefore providing erosion and slope failure prevention functions.	X		X		X						

Table 9.5 Baseline (2015/2016) Wetland Functions Overview

Individual Function	Wetland Functions	WL 6	WL 28	WL 15	WL 17	WL 22	WL 27	WL 29	WL 32	WL 35	WL 40	WL 49
Plant Community	*Degelia plumbea* (Special Concern (COSEWIC and SARA, Vulnerable (NSESA)) and *Sticta fuliginosa* (S3) were observed in 2007.			X								
	Degelia plumbea (NSESA Vulnerable, S2) observed in 2007.						X					
	Vegetation is undisturbed and presents exceptional integrity, although diversity is low.		X									
	Vegetation is undisturbed and presents exceptional integrity.	X			X				X		X	
	Vegetation is undisturbed and presents a good level of integrity, however vegetation diversity is low and comprises an invasive species (Japanese Knotweed).						X					
	Vegetative diversity is moderate, hence generating an average capacity to settle suspended sediments.	X	X	X	X	X					X	
	Wetland does not include dominant non-native, or invasive species (only small-scale cattail colonization at roadside).				X			X				
	Wetland does not include dominant non-native, or invasive species.	X	X	X		X			X		X	
Fish and Wildlife Habitat	The wetland occurs in a complex of various wetland types within 1km, which exhibit different plant communities. This provision provides valuable wildlife habitat functions (i.e., refuge, food source).	X	X	X	X	X	X	X	X			
	The wetland comprises a small interspersion of open water (watercourse) and non-open water (vegetated) community. Supports a greater wildlife function, however interspersion is minimal and only one vegetation type exists which reduces the structural diversity.	X										
	There are minimal barriers to wildlife surrounding the wetland and it is connected to more than 50ha of contiguous forested land. Therefore, ecosystem connectivity to other natural habitat and wetlands is high.	X	X	X	X	X	X	X	X		X	
	Wetland provides suitable habitat for amphibians, reptiles, and mammals.		X		X	X	X	X			X	

Table 9.5 Baseline (2015/2016) Wetland Functions Overview

Individual Function	Wetland Functions	WL 6	WL 28	WL 15	WL 17	WL 22	WL 27	WL 29	WL 32	WL 35	WL 40	WL 49
	Wetland provides suitable habitat for amphibians, reptiles, waterfowl, fish, and mammals.	X							X	x		x
	Wetland provides good snapping turtle habitat in some portions, but none observed.					X						
	Wetland provides suitable habitat for fish due to a channel connection between Moose River and the “mini pit”.					X						
	Fish access/habitat in watercourse, and wetland provides suitable spawning/nursery habitat, refuge for native fish species within some portions of wetland.			X								
	Potential fish habitat provided by presence of ephemeral watercourse, although watercourse characteristics indicate the potential is low.							X				
	Deer, Bear, Coyote signs, potential snapping turtle at beaver impoundment observed during 2015.			X								
	Snapping turtle habitat is present along Moose River within the northeastern edge of Wetland 32, outside of the planned infrastructure disturbance. No snapping turtles or evidence of snapping turtles were observed.								X			
	Moose River and adjacent fen provides suitable fish habitat, although area exists outside of planned infrastructure disturbance.								X			

9.4.1.3 Birds

Breeding bird surveys were completed at the Touquoy Mine Site in 2005 at 11 point count stations (B1 to B11) across the 2007 EARD project area. A total of 52 species were observed during these breeding bird surveys. Point count station B5 was determined to be closest to the current proposed Clay Borrow Area expansion area PDA, B9 the closest to the proposed WRSA expansion PDA, B10 closest to the proposed Plant Access Road PDA and B8 the closest to the Open Pit (Figure 5.1 in CRA (2007a)). Table 9.6 provides the results from these four 2005 point count stations with their 2007 NSDNR status and updated current 2021 conservation status and AC CDC ranks.

Table 9.6 2006 Point Count Observations at B5, B9, B10 and B8

Scientific Name	Common Name	# of Observations				NSDNR Status (2007)	2021 Status (COSEWIC, NSESA, SARA)	2021 AC CDC Status
		B5	B9	B10	B8			
Agelaius phoeniceus	Red-winged blackbird				4	Green	-	S4B
Archilochus colubris	Ruby-throated Hummingbird				1	Green	-	S5B
Bombycilla cedrorum	Cedar Waxwing				4	Green	-	S5B
Bonasa umbellus	Ruffed Grouse			2		Green	-	S5
Carduelis pinus	Pine Siskin			1	1	Green	-	S2S3
Carduelis tristis	American Goldfinch				6	Green	-	
Carpodacus purpureus	Purple Finch		15		1	Green	-	S4S5B, S3S4N
Catharus guttatus	Hermit Thrush		1	2		Green	-	S5B
Catharus ustulatus	Swainson's Thrush		1	1		Green	-	S3S4B
Colaptes auratus	Northern Flicker		1			Green	-	S5B
Corvus brachyrhynchos	American Crow				5	Green	-	S5
Corvus corax	Common Raven		1			Green	-	S5
Cyanocitta cristata	Blue Jay				4	Green	-	S5
Dendroica castanea	Bay-breasted Warbler			2		Green	-	S3S4B
Dendroica coronata	Yellow-Rumped Warbler			2		Green	-	S5B

Table 9.6 2006 Point Count Observations at B5, B9, B10 and B8

Scientific Name	Common Name	# of Observations				NSDNR Status (2007)	2021 Status (COSEWIC, NSESA, SARA)	2021 AC CDC Status
		B5	B9	B10	B8			
Dendroica magnolia	Magnolia Warbler	3	1	3	1	Green	-	S5B
Dendroica palmarum	Palm Warbler		1			Green	-	S5B
Dendroica petechia	Yellow Warbler				1	Green	-	S5B
Dendroica virens	Black-throated Green Warbler			12		Green	-	S5B
Empidonax alnorum	Alder Flycatcher		3		3	Green	-	S5B
Geothlypis trichas	Common Yellowthroat		1		1	Green	-	S5B
Hirundo rustica	Barn Swallow				4	Yellow	SARA Threatened, COSEWIC Special Concern, NSESA Endangered	S2S3B
Junco hyemalis	Dark-eyed Junco		1		1	Green	-	S4S5
Melospiza melodia	Song Sparrow				6	Green	-	S5B
Mniotilta varia	Black-and-white Warbler		1			Green	-	S5B
Parus atricapillus	Black-capped Chickadee			2	4	Green	-	S5
Parus hudsonicus	Boreal Chickadee	1				Green	-	S3
Picoides villosus	Hairy Woodpecker			1		Green	-	S5
Quiscalus quiscula	Common Grackle		1	2	20	Green	-	S5B
Regulus calendula	Ruby-crowned Kinglet	4	1			Green	-	S3S4B
Regulus satrapa	Golden-crowned Kinglet	2				Green	-	S5
Seiurus aurocapillus	Ovenbird			1		Green	-	S5B
Spizella passerina	Chipping Sparrow				1	Green	-	S4B

Table 9.6 2006 Point Count Observations at B5, B9, B10 and B8

Scientific Name	Common Name	# of Observations				NSDNR Status (2007)	2021 Status (COSEWIC, NSESA, SARA)	2021 AC CDC Status
		B5	B9	B10	B8			
Steophaga americana	Northern Parula				1	Green	-	S5B
Sturnus vulgaris	European Starling				10	Green	-	SNA
Troglodytes troglodytes	Winter wren		1		1	Green	-	S5B
Turdus migratorius	American Robin				8	Green	-	S5B, S3N
Vireo olivaceus	Red-eyed Vireo			5		Green	-	S5B
Vireo solitarius	Blue-headed Vireo		2			Green	-	S5B
Zenaida macroura	Mourning Dove				12	Green	-	S5
Zonotrichia albicolis	White-Throated Sparrow		2			Green	-	S5B
Bonasa umbellus	Ruffed Grouse			2		Green	-	S5

Three additional species were recorded incidentally outside of the breeding bird surveys in 2006. Two species were observed during wetland surveys, pileated woodpecker (*Dryocopus pileatus*, S5) and spruce grouse (*Dendragapus canadensis*, S4). A barred owl (*Strix varia*, S5) was observed near the Moose River during groundwater sampling. Three other owl species were also confirmed within the 2007 EARD project site by the breeding bird surveyor: Northern Saw-whet Owl (*Aegolius acadicus*, S4B), Great Horned Owl (*Bubo virginianus*, S4), and Long-Eared Owl (*Asio otus*, S2S3) (CRA 2007a). None of these species are listed under NSESA, COSEWIC or SARA.

Priority Bird Species

An assessment was conducted for the 2007 EARD (CRA 2007a), and revised for the 2007 Focus Report (CRA 2007b), of priority avian species with the potential to occur within the Project area. This assessment included a review of AC CDC records within 100 km of the Project and habitat modeling to assess the likelihood of priority avian species presence based on habitat types within the Project area. This exercise found that one of priority species, Northern goshawk (*Accipiter gentiles*; S3S4), had a high likelihood of using habitat within the 2007 EARD project site, specifically mature forest stands. The Northern goshawk is not listed under NSESA, COSEWIC or SARA. The rusty blackbird (*Euphagus carolinus*, S2B; COSEWIC/SARA Special Concern; NSESA Endangered) was assessed to have a moderate likelihood of using habitat within the project site, specifically treed wetlands, and adjacent uplands. There were no observations of rusty blackbird during dedicated avian surveys or incidentally. Other priority species listed in the AC CDC report were not expected to be present in the 2007 EARD project site due to the lack of suitable habitat.

9.4.1.4 Wildlife

Evidence of the following fauna species in Table 9.7 were identified during baseline surveys completed in 2004 and 2005 to support the 2007 EARD (CRA 2007a).

Table 9.7 Fauna Species Observed in 2004 and 2005

Scientific Name	Common Name	2021 Status (COSEWIC, NSESA, SARA)	2021 AC CDC Status
Vulpes vulpus	Red Fox	-	S5
Canis latrans	Coyote	-	S5
Tamiasciursus hudsonicus	Red Squirrel	-	S5
Lepus americanus	Snowshoe Hare	-	S5
Ursus americanus	American Black Bear	-	S5
Odocoileus virginianus	White-tailed Deer	-	S5
Alces alces americana	Mainland Moose	Endangered (NSESA)	S1

A herpetile-specific survey was conducted in 2004 along with incidental observations collected during other field surveys in 2004 and 2005. No herptiles were described in the 2007 EARD at the Touquoy Mine Site.

The 2007 EARD (CRA 2007a) determined that suitable habitat for the species presented in Table 9.8 was present within the Touquoy Mine Site.

Table 9.8 Fauna Species Predicted to be Present at the Touquoy Mine Site

Scientific Name	Common Name	2021 Status (COSEWIC, NSESA, SARA)	2021 AC CDC Status
Lynx rufus	Bobcat	-	S5
Procyon lotor	Raccoon	-	S5
Mephitis mephitis	Striped Skunk	-	S5
Microtus pennsylvanicus	Meadow Vole	-	S5
Clethrionomys gapperi	Red-backed Vole	-	S5
Tamias striatus	Eastern Chipmunk	-	S5
Blarina brevicaudata	Short-tailed shrew	-	S5
Myotis lucifugus	Little Brown Myotis	Endangered (COSEWIC, NSESA, SARA)	S1
Myotis septentrionalis	Northern Long-eared Bat	Endangered (COSEWIC, NSESA, SARA)	S1

Priority Wildlife Species

Of the above recorded species, the following are currently listed under NSESA, COSEWIC or SARA.

- Mainland moose (NSESA: Endangered)
- Little brown bat (NSESA, COSEWIC and SARA: Endangered)
- Northern long-eared bat (NSESA, COSEWIC, and SARA: Endangered)

Wood turtles (*Glyptemys insculpta,* SARA/COSEWIC/ NSESA Threatened, S3) have been reported historically within the of Moose River Gold Mines area, however, the nearest AC CDC record from the 2007 EARD was within 30 km of the Touquoy Mine Site and 40 years old. A targeted wood turtle habitat survey conducted in 2004 within the 2007 EARD project area did not reveal any nesting or hibernating sites for wood turtles. No evidence of wood turtles or suitable breeding or hibernating habitat was observed in any of the 2005 or 2006 field surveys.

While no snapping turtles (*Chelydra serpentina,* SARA/COSEWIC Special Concern, NSESA Vulnerable, S3) were observed during the 2007 EARD targeted turtle surveys or incidentally, potential habitat is present within the LAA. 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 (> 50 cm) during the winter, with a mucky or muddy substrate. Females target gravel areas to nest, such as roadside berms (ECCC 2020). Since the 2007 EARD submission, snapping turtles have been observed incidentally in proximity to the Touquoy Mine Site (Section 9.4.2.5).

The 2007 EARD (CRA 2007a) states that a population of about 20 mainland moose live in the Tangier Grand Lake Wilderness Area, located approximately 10 km southeast of the Touquoy Mine Site (CRA 2007a). Prior to the development of the Touquoy Mine Site, evidence of moose was observed annually during deer pellet surveys conducted by NSDNR. However, the 2007 EARD concluded that moose numbers are very low and highly dispersed in the area surrounding the Touquoy Mine Site.

Northern long-eared bat and the little brown bat were presumed to be present within the general area of the Touquoy Mine Site, using the local habitat for summer foraging. Although over 100 abandoned mine openings were mapped within 500 m of the Touquoy Mine Site, approximately 75% of the mapped abandoned mine openings were less than 6 m deep with the remaining either blocked or filled with water as confirmed through extensive surveys conducted by NSDNR. No suitable hibernacula were presented in the 2007 EARD and no known hibernacula for these species were recorded by the Nova Scotia Museum or AC CDC.

9.4.2 Existing Conditions

Existing conditions (current baseline) of the terrestrial environment within the LAA are described below. This section reflects data collected since the Touquoy Mine Site has been operational, generally in 2019-2021 and describe existing conditions.

9.4.2.1 Vegetation Community and Classification

The identified LAA consist of a mosaic of forested and non-forested upland, wetland, and riparian communities. The landscape within the LAA in part, has been historically disturbed consisting of conifer-dominant communities. Intact upland and wetland forested communities also exist within the LAA. Eight vegetation types within six community groups have been identified and are discussed in Table 9.9 and presented in Figure 9.3.

Prepared For:

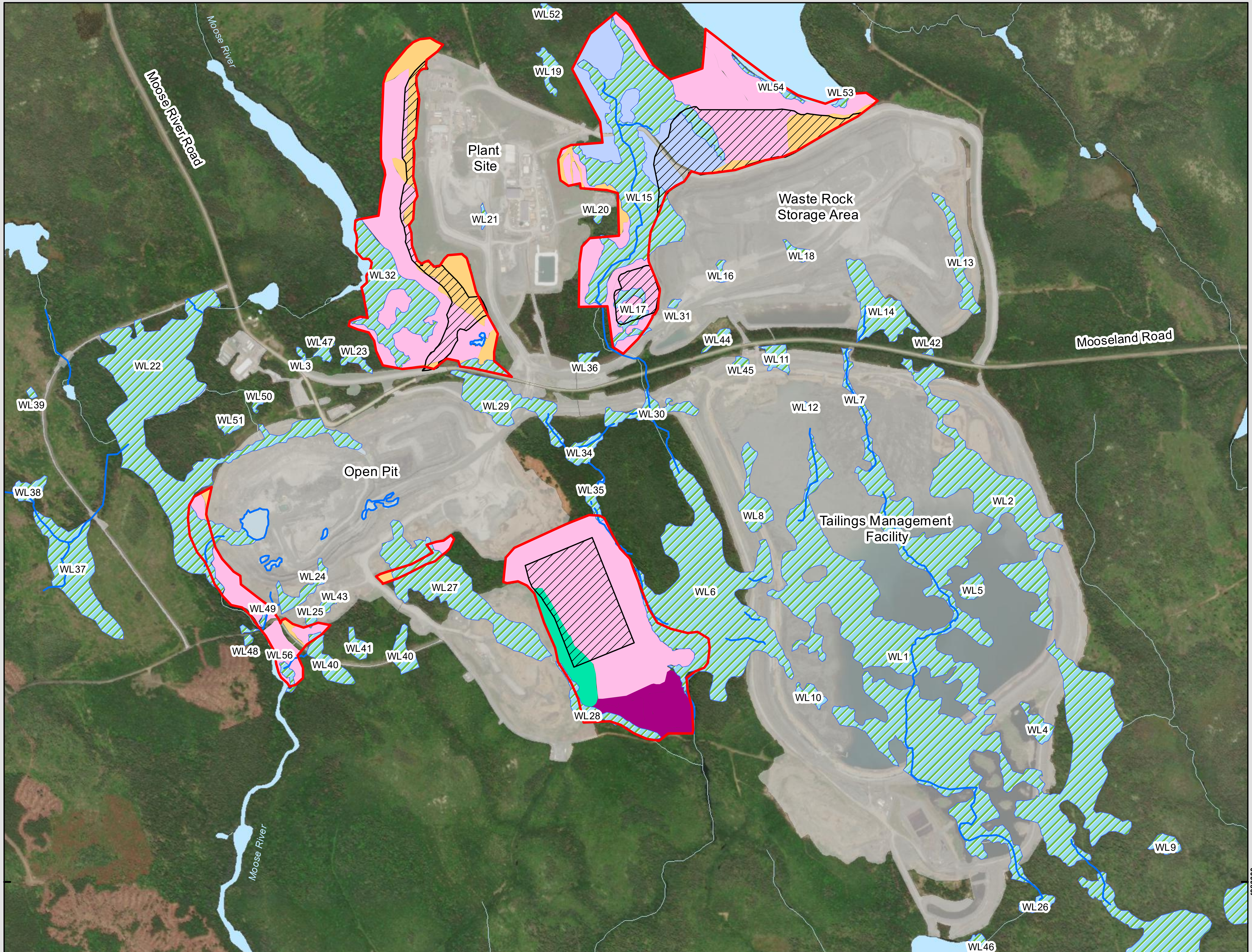
Atlantic Gold

FIGURE 9.3

Touquoy Gold Project

2021 EARD

Vegetation Communities within the LAAs



Field Delineated Watercourse
NSECC Mapped Watercrouse
Waterbody
Field Delineated Wetland

Vegetation Community

Cutover
IH6 – White Birch – Red Maple / Sarsparilla - Bracken
SH6 - Red Spruce - Balsam Fir / Stair Step Moss - Sphagnum
SH8 – Balsam Fir / Wood Fern / Schreber's Moss
SP5 – Black Spruce / Lambkill / Bracken
LAA (Indirect Impact Extent)
PDA (Direct Impact Extent)
Touquoy Mine Site Existing Footprint

Coordinate System: NAD 1983 CSRS UTM Zone 20N
Projection: Transverse Mercator
Datum: North American 1983 CSRS
Units: Meter

0 125 250 500 m

1:10,000 Scale when printed @ 11" x 17"

Drawn By: SS
Reviewed By: MM
Date: 2021-06-25

McCallum Environmental Ltd.

Document Name: 210602_TQ EA_VegCommunities

Table 9.9 Vegetation Community Groups and Vegetation Types Observed within the LAA

Community Type	Vegetation Group	Vegetation Type	Successional Stage of Vegetation Type	Classification System*	LAA where Vegetation Type is Present			
					WRSA Expansion	Clay Borrow Area Expansion	Plant Access Road	Open Pit
Upland Communities	Spruce Hemlock Forest Group	SH6 – Red Spruce – Balsam Fir / Stair-step Moss - Sphagnum	Mid	FEC	-	x	-	-
		SH8 – Balsam Fir / Wood Fern / Schreber's Moss	Early - Mid		x	-	x	x
	Spruce Pine Forest Group	SP5 – Black Spruce / Lambkill / Bracken	Early - Late	FEC	x	-	-	-
	Intolerant Hardwood Forest Group	IH6 – White Birch – Red Maple / Sarsparilla - Bracken	Early	FEC	-	x	-	-
Wetland Communities	Wet Coniferous Forest Group	WC – Black Spruce / Lambkill – Labrador Tea / Sphagnum	Mid - Late	FEC	-	x	x	-
		WC 6 – Balsam fir / Cinnamon fern – Three Seeded Sedge / Sphagnum	Early - Mid		x	x	-	x
	Peatland Group	PG2- Sweetgale Mixed Shrub Fen	Mid	NCE adapted	-	x	x	-
	Shrub Swamp Group	MH1 - Mountain Holly - Alder Swamp		NCE adapted	x	-	-	x

*Classification of forested and non-forested community types were completed by merging several existing classification systems. For forested community types, the Nova Scotia Department of Natural Resources (NSDNR) Forest Ecosystem Classification (FEC) (Neily et al., 2010) was used. In the event surveyors encountered non-forested community types which were not defined by the FEC system, the following classification system was used: *Maine Natural Areas Program - Natural Communities and Ecosystems* (NCE) (Government of Maine, 2017).

Within the LAA, the three upland community groups: Spruce Hemlock (SH), Spruce Pine (SP), Intolerant Hardwood (IH) and two wetland community groups: Wet Coniferous (WC) and the Peatland Group (PG) were observed. Within these groups, seven vegetation types ranging from early to mid-successional, none of which are uncommon in Nova Scotia were observed. See below descriptions of all the community groups and vegetation types observed.

Upland Communities

Spruce Hemlock Forest Group (SH)

This vegetation group is widespread throughout Nova Scotia and consists of mid to late successional vegetation types (Neily et al. 2010). This vegetation group is dominated by a canopy consisting of shade tolerant softwoods such as balsam fir, red spruce, and eastern hemlock. The shrub layer often consists of regenerating conifers and soils which are often derived from glacial till (Neily et al. 2010). Two vegetation types belong to this group are present within the LAA.

SH6 – Red Spruce – Balsam Fir / Stair-step Moss - Sphagnum Moss

The SH6 vegetation type is dominated by red spruce and balsam fir. The herbaceous layer typically was poorly developed, with the most prominent species being bunch berry (*Cornus canadensis*), sheep laurel (*Kalmia angustifolia*), bracken fern (*Pteridium aquilinum*) and American wintergreen (*Gaultheria procumbens*). The bryoid layer in this vegetation type was predominantly Schreber's moss (*Pleuorzium schreberi*) and Sphagnum species such as *S. girgensohnii* and *S. capillifolium* in depressions and isolated hummocks.

Photo 9.1 Representative photo of the SH6 vegetation type (mature and intact) stand

SH6 was only observed in the southern portion of the Clay Borrow Area expansion LAA, in regenerative and mature stands with varying stand age. This vegetation type provides suitable habitat for hare, moose foraging and passerine foraging and breeding and is found on acidic nutrient poor soils. Rare vascular flora potential within this vegetation type is low. Within this vegetation type, cyanolichen habitat for SAR blue felt lichen (*Pectenia plumbea*) and boreal felt lichen (*Erioderma pedicellatum*) is not present. This vegetation type does provide habitat for some SOCI lichen species such as red beard lichen (*Usnea rubicunda*) which was observed within the LAA (Section 9.4.2.2).

SH8 – Balsam Fir / Wood Fern / Schreber's Moss

The SH8 vegetation type is an early to mid-successional community type which is dominated by balsam fir and often indicative of disturbances such as harvesting, insect infestation and windthrow (Neily et al. 2010). The herbaceous layer is often variable within this vegetation type and in some instances the canopy cover is so dense that very little herbaceous cover is present. Typically, however, and as seen within the LAA, the herbaceous layer consisted of Canada bunchberry and star flower (*Lysimachia borealis*). The bryoid layer consisted of wavy-leaved moss (*Dicranum polysetum*.), hypnum mosses (*Hypnum spp*.) and *Bazzania spp*.

SH8 was the dominant upland vegetation type within the LAA and was associated with historical disturbances which is reflective of the even aged stand and poorly developed herbaceous layer. In the north, the stands were mature while in the eastern and southern portions, dense regenerative balsam fir (in shrub form) were present. The regenerative portions of this vegetation type provide suitable habitat for refuge and foraging for hare and for moose and passerines. Rare vascular flora and lichen potential for this vegetation type is low.

Photo 9.2 Representative photo of the SH8 vegetation type

Spruce Pine Forest Group (SP)

The Spruce Pine forest group consist of vegetation types that are associated with nutrient poor soils which are often associated with forest disturbances (Neily et al. 2010). Within this group conifer species, primarily spruce and pine are often dominant. Within this forest group and a result of the nutrient-poor acidic soils, ericaceous species are often present within this group.

SP5 – Black Spruce / Lambkill / Bracken Fern

The SP5 vegetation type observed is dominated by black spruce with an understory consisting of black spruce saplings, sheep laurel and bracken fern. This vegetation type had a well-developed shrub and herbaceous layer. The bryoid layer consisted primarily of Schreber's and stair-step moss.

SP5 was observed with the WRSA expansion LAA and consisted of nutrient poor soils with a very low potential to support vascular plant rarities. Due to the predominant tree species being black spruce, the potential to support many SAR lichen species is low. Habitat for red beard lichen is present within this vegetation type. This vegetation type supports foraging and breeding for many passerine bird species.

Photo 9.3 Representative photo of the SP5 vegetation type

Intolerant Hardwood Forest Group (IH)

Vegetation groups within the Intolerant Hardwood Forest Group are early to mid-successional and often short lived with an even-aged stand. Typically, the vegetation types associated with this group have had some sort of stand-level disturbance (Neily et al. 2010). The shrub and herb layers are usually developed with a poorly formed bryoid layer.

IH6 – White Birch – Red Maple / Sarsaparilla – Bracken Fern

The IH6 vegetation type is an early successional vegetation type often associated with disturbances and is widespread throughout Nova Scotia. The dominant tree and shrub species of this vegetation type are white birch and red maple with scattered balsam fir. The observed herbaceous layer was poorly developed and scattered bryophytes such as stair-step moss, Schreber's moss, and wavy-leaved moss were present.

IH6 was isolated to the western boundary of the Clay Borrow Area expansion LAA and was historically cleared. Rare vascular plant potential in this vegetation type is low and the tree maturity (immature vs. mature) suitable for many priority lichen species was lacking. This vegetation type provides habitat for foraging for passerine birds, hare, and small rodents.

Photo 9.4 Representative photo of the IH6 vegetation type

Wetland Communities

The wetland vegetation community is described in the section below. For further details on the wetland types, classification, landscape position and overall wetland characteristics see Sections 9.4.1.2 and 9.4.2.3 (Figure 9.3).

Wet Coniferous Forest Group (WC)

The Wet Coniferous Forest Group is a wet forested ecosystem which often has water at or near the surface of the soil for most of the year (Neily et al. 2010). This forested vegetation group is often associated with swamps in Nova Scotia. Stand cover of trees is typically moderate to high, often with extensive sphagnum cover and acidic and nutrient poor soils. Fern species, such as cinnamon fern (*Osmunda cinnamomea*) and sedges such as the three-seeded sedge (*Carex trisperma*) are often associated with this vegetation community group.

WC2 – Black Spruce / Lambkill – Labrador tea / Sphagnum Moss

WC2 is a common vegetation type throughout Nova Scotia and was observed within Wetland 6 and Wetland 32, in the Clay Borrow Area expansion and Plant Access Road LAA areas, respectively. This vegetation type typically has high shrub and Sphagnum moss cover. Within the LAA this vegetation type was dominated by black spruce, Labrador tea, lambkill and three-seeded sedge. The shrub layer also consisted of black spruce saplings. The bryoid layer primarily consisted of Sphagnum angustifolium, S. capillifolium, S.palustre and S. magellanicum s.l..

This vegetation type had low potential to support vascular plants because of the nutrient poor acidic soils, and the tree species (primarily black spruce) typically do not support SAR lichen species within Nova Scotia. The red beard lichen, which is present on site, was found within this vegetation type.

Photo 9.5 Representative photo of the WC2 vegetation type

WC6 – Balsam Fir / Cinnamon Fern – Three Seeded Sedge / Sphagnum Moss

The WC6 vegetation type is characterized by balsam fir being the dominant tree species with extensive sphagnum and cinnamon fern cover. Within the LAA, this vegetation type was found on wet soils; however, this community can also occur on imperfectly drained upland soils (Neily et al. 2010). The shrub layer is often variable and can range from low to high, which often comprise of mountain holly and speckled alder. The dominant graminoid and bryophyte species in this vegetation type is three seeded sedge and Sphagnum moss.

WC6 was observed within the Clay Borrow Area expansion, WRSA expansion and Open Pit LAA, in Wetland 6, Wetland 15, Wetland 17 and Wetland 27. Where observed, this vegetation type had extensive Sphagnum cover, predominately consisting of *S. palustre* and *S. capillifolium* and scattered mature red maples which had potential to support the SAR blue felt lichen; however, none were observed during the surveys. In the broad sense, WC6 can support boreal felt lichen within the right circumstance (i.e., away from clearings and with the right bryophyte and lichen community). The wetlands where this vegetation type was observed within the LAA lacked the suite of indicator species which are often indicative of boreal felt lichen (Section 9.4.2.2 (Lichens subsection) for details) and no thalli were observed.

Photo 9.6 Representative photo of the WC6 vegetation type

Peatland Vegetation Group (PG)

For the purpose of this EARD, all vegetation types associated with peatlands (i.e. bogs and fens) have been grouped together. This vegetation community group often consists of extensive sphagnum moss cover, graminoids (sedges and grasses), and sparse tree cover, often with the presence of carnivorous plant species.

PG2 - Sweetgale Mixed Shrub Fen

The PG2 vegetation type is typically found bordering lakes and ponds and often associated with larger wetland complexes and is widespread within Nova Scotia (Basquill 2020, pers. comm.). This vegetation type is characterized by the high shrub cover consisting of sweetgale and leatherleaf.

PG2 was found in the Clay Borrow Area expansion and Plant Access Road LAA, in Wetland 6 along Watercourse #3, and Wetland 32 along the Moose River. Within this vegetation type, graminoid cover was low and bluejoint grass (*C. canadensis*) was scattered throughout. Scattered tamarack was also observed. The bryoid layer was sphagnum dominant consisting of *S. palustre, S. capillifoliumm, S.rubellum, S. papillosum, S. affine* with trace amounts of other bryophytes associated with fens such as *Staminergon stamineum* and *Aulocomnium palustre*. The dense shrub layer provides suitable habitat for breeding for the SAR Canada warbler (*Cardellina canadensis*).

Photo 9.7 Representative photo of the PG2 vegetation type

Mountain Holly – Alder Shrub Swamp (MH1)

The MH1 vegetation type has been adapted from the NCE as there are many similarities between the community types observed within the LAA and what has been described by NCE. The main difference is this vegetation type was observed associated with swamps and not fens. This discrepancy, however, could be attributed to different wetland classifications used in the U.S. and Canada.

MH1 was observed within large wetland complexes, such as Wetland 15 and 22 within the WRSA expansion and Plant Access Road LAA and dominated by speckled alder with scattered and mountain holly with a shrub cover usually over 70%. The herbaceous layer is well developed and always consisted of cinnamon fern, three seeded sedge, Sphagnum spp., and bunch berry. This vegetation type is suitable habitat for many passerine birds, particularly the SAR Canada warbler, which nests in wetlands with a well-developed shrub layer (Ontario Government 2019).

Photo 9.8 Representative photo of the MH1 vegetation type, which provides suitable nesting habitat for Canada warbler

Summary of Vegetation Types within the LAA

Provincial rarity rankings for vegetation communities within Nova Scotia do not exist. Additionally, not all the communities found in Nova Scotia have been described and researched; therefore, data are lacking to confidently designate a community type as “rare”. However, based on field survey results and desktop review, it was determined that the vegetation community types encountered within the LAA are common throughout Nova Scotia.

Both the upland and wetland communities observed were conifer dominant and belong to the Spruce Hemlock (SH), Spruce Pine (SP), Intolerant Hardwood (IH), Wet Coniferous (WC) and the Peatland Group (PG). Many of the vegetation types observed within the LAA were disturbed at some point, with the most prevalent vegetation type being the SH8 - Balsam Fir / Wood Fern / Schreber's Moss which is early to mid-successional and a common forested community which develops after timber harvesting and other disturbances (Neily et al. 2010).

The vegetation types which provide the highest potential to support priority species were within the Wet Coniferous Forest Group, which provides habitat for priority lichen species such as blue felt lichen, red beard lichen and white-rimmed shingle lichen (*Fuscopannaria leucosticta*). In general, soils were nutrient poor and acidic and did not support habitat for many of Nova Scotia plant rarities which require alkaline soils often associated with gypsum bedrock. Southern twayblade (*Neottia bifolia*), which is known in the general area, has potential to be present within the PG1 – Sweetgale fen community type within Wetland 6 and Wetland 32; however, the dense shrub cover may out compete this species.

The varying stand maturity (regenerative and mature) provide habitat for priority passerine bird species such as boreal chickadee and Canada jays. The regenerative forested communities, particularly belonging to the SP and SH forest group, provide foraging habitat for ungulates such as moose and deer, and rodents such as hare.

9.4.2.2 Vegetation

Vascular Flora

Based on the review of an AC CDC report retrieved in 2020, no priority vascular flora or non-vascular flora (excluding lichens) were observed with the LAA and within a 5-km radius of the Study Area. No priority vascular flora were observed within the LAA during the wetland monitoring programs since their implementation or during the surveys in support of the 2007 EARD (CRA 2007a).

Community types which had the highest potential for priority flora species were the *PG1 – Sweetgale fen* located in Wetlands 6 and 32, which has the potential to support southern twayblade (*Neottia bifolia*), however, none were observed during the 2007 EARD (CRA 2007a) and during the wetland monitoring program. The remainder of the vegetation types within the LAA are early to mid-successional vegetation types often associated with stand level disturbances and have low potential to support vascular flora rarities.

Lichens

No rare lichens have been reported within the LAA based on the 2020 AC CDC report; however, several species were observed within 5 km of the LAA (Table 9.10).

Table 9.10 2020 AC CDC Lichen Results

Scientific Name	Common Name	Current AC CDC S-Rank	Current Status (COSEWIC, NSESA, SARA)
Erioderma pedicellatum	Boreal felt lichen	S1	COSEWIC,NSESA, SARA: Endangered
Fuscopannaria leucosticte	White-rimmed shingles lichen	S2S3	COSEWIC: Threatened
Sclerophora peronella	Frosted glass whiskers	S1?	COSEWIC & SARA: Special Concern
Pectenia plumbea	Blue felt lichen	S3	COSEWIC & SARA: Special Concern; NSESA: Vulnerable
Leptogium subtile	Apressed jellyskin lichen	S3	-
Fuscopannaria ahlneri	Corrugated shingles ichen	S3	-
Moelleropsis nebulosa	Blue-gray Moss shingle lichen	S3	-
Coccocarpia palmicola	Salted shell lichen	S3S4	-

In 2020/2021, all historical lichen locations originally identified to support the 2007 EARD (CRA 2007a) were visited and all lands within the current EARD LAA were resurveyed for lichens.

Six priority species were observed within the LAA, which include one SAR and five SOCI species. See Figure 9.4 and Table 9.11 for lichen observations, from all survey years, within the LAA. Descriptions of each lichen SAR/SOCI observed within the LAA are presented below (Table 9.11).

Table 9.11 Current Priority Lichen Species observed within the LAA

Scientific Name	Common Name	Current AC CDC S-Rank	Current Status (COSEWIC, NSESA, SARA)
Fuscopannaria leucosticte	White-rimmed Shingles lichen	S2S3	COSEWIC: Threatened
Pectenia plumbea	Blue felt lichen	S3	COSEWIC & SARA: Special Concern; NSESA: Vulnerable
Fuscopannaria ahlneri	Corrugated shingles lichen	S3	-
Leptogium corticola	Blistered jellyskin lichen	S3	-
Usnea rubicunda	Red beard lichen	S3	
Collema leptaleum	Crumpled bat's wing lichen	S3	-

White Rimmed Shingles Lichen

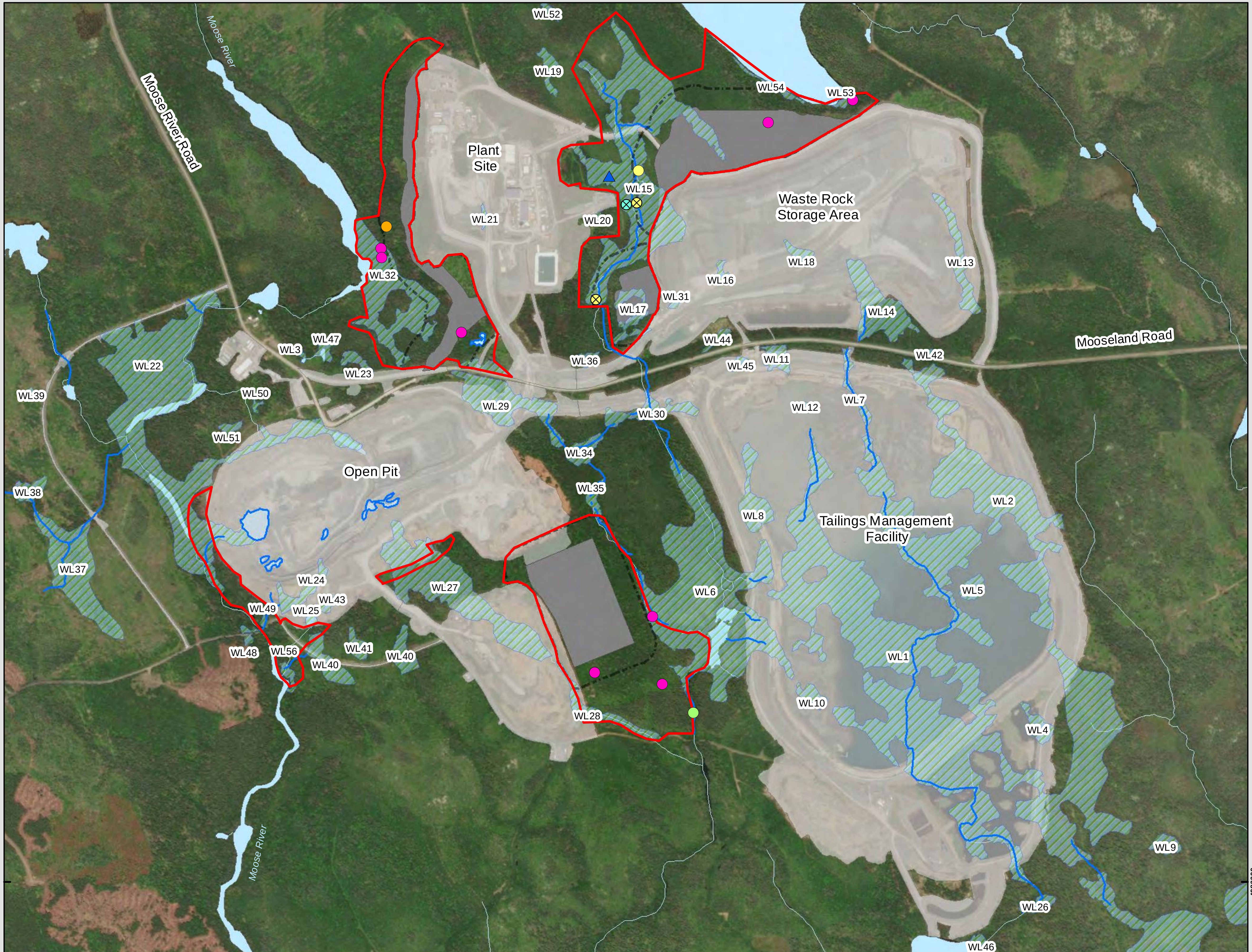
White rimmed shingles lichen is a cyanolichen consisting of a photobiont belonging to the *Nostoc* genus. This lichen consists of many overlapping small thallus lobes (squamulose habit) often with a prominent black hypothallus and tomentose white rimmed thallus lobes (Hinds and Hinds 2007). This species lacks vegetative propagules and reproduces through the production of ascospores.

White rimmed shingles lichen is known from 502 trees, in 88 occurrences consisting of 1,663 thalli in Canada (COSEWIC 2019). This species is almost exclusively found on trees within wet forests, and on red maple in Nova Scotia and on eastern white cedar in New Brunswick and Ontario (COSEWIC 2019).

One large thallus covering the lower part of a mature red maple was observed in the southern portion of the Clay Borrow Area expansion LAA, in upland habitat adjacent to Watercourse #4 (Figure 9.4).

Blue Felt Lichen

Blue felt lichen is a large blue-grey foliose lichen typically with a thick thallus with a prominent dark blue hypothallus (COSEWIC 2010). This species has apothecia which typically lack margins and vegetative propagules are lacking. The photobiont is a cyanobacteria belonging to the genus Nostoc (COSEWIC 2010).



Prepared For:

Atlantic Gold

FIGURE 9.4

Touquoy Gold Project

2021 EARD

Current Priority Lichens within the LAAs

Blue felt lichen (SAR)

SOCI Lichen

- Crumpled bat's wing lichen
- Corrugated shingles lichen
- White-rimmed shingles lichen
- Blistered jellyskin lichen
- Red beard lichen
- No Longer Extant

Field Delineated Watercourse

NSECC Mapped Watercrouse

Waterbody

Field Delineated Wetland

60 m PDA Buffer

LAA (Indirect Impact Extent)

PDA (Direct Impact Extent)

Touquoy Mine Site Existing Footprint

Coordinate System: NAD 1983 CSRS UTM Zone 20N
Projection: Transverse Mercator
Datum: North American 1983 CSRS
Units: Meter

0 125 250 500 m

1:10,000 Scale when printed @ 11" x 17"

Drawn By: SS
Reviewed By: MM
Date: 2021-06-25

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Document Name: 210602_TQ EA_CurrentSARSCOILichen

In Canada, blue felt lichen is an eastern species found only in Nova Scotia, New Brunswick, and Newfoundland. Outside of Canada it is found in western Europe and a few occurrences within Maine, U.S. (COSEWIC 2010). Blue felt lichen is often associated with humid treed swamps found growing on mature broad-leaf trees such as red maple (*Acer rubrum*), ash (*Fraxinus spp*.) and yellow birch (*Betula alleghaniensis*).

One occurrence of blue felt lichen, in Wetland 15, is within the current WRSA expansion LAA (Figure 9.4). An additional three occurrences of blue felt lichen have been observed throughout the Touquoy Mine Site (Wetland 27, 34, 40); however, these are outside of the LAA presented as part of this EARD. These occurrences are beyond the area of predicted indirect effects, and a minimum 100 m setback from the PDA has been applied.

Corrugated Shingles Lichen

The corrugated shingles lichen is a cyanolichen often associated with mature deciduous trees (Hinds and Hinds 2007). Typically, this species is foliose, forms small rosettes and has a brown scabrid upper surface with coarse marginal soredia. This species can be distinguished from the similar looking powdery shingles lichen (*F. sorediata*), by the difference in habit (foliose vs. squamulose) and position of soralia (marginal vs. labriform), however, at times, specimens with intermediate characteristics exist which can make it challenging to confidently identify.

Three observations occurred during the 2004-2020 surveys which are within the current WRSA expansion LAA, and were all in Wetland 15, however, only one occurrence is extant (Figure 9.4).

Red Beard Lichen

Red beard lichen is an unusual *Usnea* in the sense that it often has a red pigment which is deeply within the cortex (Hinds and Hinds 2007). This species listed as imperiled/vulnerable (S2S3) by the AC CDC. Care must be taken when identifying this species as other beard lichens occasionally express red pigments on the surface of the cortex. This species can be differentiated by the red pigment being deeply within the cortex and a K+ yellow reaction within the medulla. The red beard lichen is often associated with mature conifer forests both upland and wetland, and has been recorded in Digby, Colchester, and Halifax counties (CNALH 2020).

Eight occurrences of red beard lichen were observed within the LAA (Figure 9.4). One of these occurrences is within the proposed WRSA expansion PDA.

Blistered Jellyskin Lichen

Blistered jellyskin lichen is a small to medium jelly cyanolichen with a slate gray thallus when dry and greenish-black when wet. Apothecia are common in this species which consist of brown to reddish disks and a thick margin. As the common name suggests, this species is characterized the heavily and irregular blistered (pustulate) upper thallus. Blistered jellyskin lichen is known from eastern North America and Europe commonly found on mature hardwood species. In Nova Scotia, specimens have been collected in Shelburne, Yarmouth, and Annapolis counties (CNALH 2021); however, as is the trend for most lichen species, it appears to be a misrepresentation of the true distribution of this species. This species is listed as Vulnerable (S3) by the AC CDC.

Within the LAA, one occurrence of the blistered jellyskin lichen was previously observed in Wetland 15; however, it was not observed in the 2020 surveys and is believed to be no longer extant.

Crumpled Bat's Wing Lichen

Crumpled bat's wing lichen is a pulvinate cyanolichen consisting of lobes forming an anastomosing network of expanded and contracted flat sheets. This species, in Nova Scotia, is often associated with aspen (*Populus sp.*) which can occur in wetlands and upland habitats.

One occurrence was observed in the Plant Access Road LAA consisting of approximately 14 thalli. The observation was found on a mature trembling aspen (*Populus tremeloides*) in the SH8 – Balsam fir / wood fern / Schreber's moss vegetation type.

Summary of Vascular Flora and Lichens within the LAA

No priority vascular flora was noted within or within 5 km of the LAA (AC CDC 2020), observed during the 2007 EARD surveys or the ongoing wetland monitoring programs. Community types which have the highest potential for priority vascular flora species were the *PG1 – Sweetgale fen* located in Wetland 6 (Clay Borrow Area expansion LAA) and Wetland 32 (Plant Access Road LAA), which has the potential to support southern twayblade; however, none were observed during the 2007 EARD surveys or during the ongoing wetland monitoring program.

The Wet Coniferous Forest Group provides the highest potential habitat for priority lichen species. A SAR lichen was observed within this vegetation group (WC6 vegetation type) within the LAA: one blue felt lichen occurrence within Wetland 15 in the WRSA expansion LAA. Ten additional SOCI lichen occurrences were observed to be extant within the LAA.

9.4.2.3 Wetlands

As discussed in Section 9.4.1.2, Wetlands 53 and 54, situated within the WRSA expansion LAA, were assessed in 2019. Wetland 56 was identified and assessed in 2021 and is located within the Open Pit LAA. Wetland characteristics for these wetlands are provided in Table 9.12. Functional assessments have not yet been completed in these wetlands to date.

Wetlands 25 and 29 have since been assessed as completely altered and removed from the monitoring program and are therefore not discussed further herein.

In addition, a wetland and watercourse delineation report was compiled in January 2020 outlining the results of assessments completed for Wetland 53 and 54. The report is provided in Appendix E.1.

Table 9.12 Baseline Wetland Characteristics Overview

WETLAND ID	WETLAND TYPE	HYDRIC SOIL TYPE	SURFACE HYDROLOGY	WETLAND BOUNDARY/BUFFER	DOMINANT VEGETATION	WATER INFLOW/ OUTFLOW
WRSA Expansion LAA (2019)						
WL53	Bi-directional lentic coniferous treed fen	1. 50 cm organic soil depth 2. A1 Histosol	1. Intermittent surface water 2. High water table 3. Saturation	High (10%), moderate (10%) and low (80%) slope; natural buffer ~21 m	Herbs Phalaris arundinacea and Chamaedaphne calyculata Shrubs and Trees Abies balsamea, Picea mariana Larix laricina	Surface water run-off from surrounding upland habitat and bi-directional flow from Square Lake.
WL54	Isolated coniferous treed swamp	1. 20 cm depth 2. A2 Histic Epepidon	1. High water table 2. Saturation	High (10%), moderate (10%) and low (80%) slope; natural buffer ~21 m	Herbs Osmunda cinnamomea, Kalmia angustifolia Shrubs and Trees Abies balsamea	Intercepts surface water run-off from surrounding low gradient upland habitat.
Open Pit LAA (2021)						
WL56	Bi-directional lentic coniferous swamp (however, primarily isolated most of the year)	1. 20 cm depth 2. A2 Histic Epipedon	1. High water table 2. Saturation	High (70%), moderate (30%) slope natural buffer >50 m	Herbs Onoclea sensibilis Shrubs Kalmia angustifolia Trees Abies balsamea and Acer rubrum	Adjacent Moose River is entrenched most of the year, however, at high flow events, bi-directional flow likely occurs within wetland.

Based on existing conditions, a total of 13 wetland exist, either fully or partially, within the current EARD LAA. The 13 wetlands, their total unaltered area and status are presented in Table 9.13.

Table 9.13 Total Wetlands in the LAA from All Study Years

Wetland ID	LAA	Area (ha)	Current Impact
6	Clay Borrow Area Expansion	11.45	TMF
28	Clay Borrow Area Expansion	0.85	Organics Stockpile
35	Clay Borrow Area Expansion	0.28	No direct alteration
15	WRSA Expansion	9.55	Existing WRSA, Plant Access Road
17	WRSA Expansion	0.61	Existing WRSA
53	WRSA Expansion	0.08	No direct alteration
54	WRSA Expansion	0.21	No direct alteration
22	Open Pit	12.63	Open Pit
27	Open Pit	4.90	Open Pit, Organics Stockpile
40	Open Pit	0.75	Plant Access Road
49	Open Pit	0.04	No direct alteration
56	Open Pit	0.17	No direct alteration
32	Plant Access Road	3.59	No direct alteration

NOTE:
Wetland 25 (Pit LAA) and 29 (Plant Access Road LAA) have been assessed as completely altered and are not included herein.

Portions of some of the wetlands situated within the LAA have been subject to partial direct alteration since 2015. A wetland monitoring program has been implemented across the Touquoy Mine Site since 2016 to support the determination of potential indirect impacts to unaltered wetlands and has been used to provide a summary of current wetland conditions within the LAA. Table 9.14 identifies which wetlands have been subject to direct alteration and notes those which have been monitored since 2016 including a summary of monitoring results.

Detailed wetland monitoring results are presented in the 2020 Wetland Post Construction Monitoring Report (SD 21) (submitted to NSECC on March 31, 2021).

Table 9.14 Wetland Monitoring Conditions

WETLAND ID	DIRECT ALTERATION DETAILS	POST-CONSTRUCTION MONITORING SCOPE	POST-CONSTRUCTION MONITORING SUMMARY
CLAY BORROW AREA EXPANSION LAA			
6	1.66 ha altered on eastern extent (TMF footprint)	Monitoring being completed: Hydrological conditions via monitor well/data loggers. Vegetation transects General visual observations	Monitoring results indicate that wetland characteristics and function are being maintained.
28	0.37 ha altered at northern extent of wetland (Scraggy Lake organics stockpile.)	Monitoring being completed: Hydrological conditions via monitor well/data logger. Vegetation transects	Monitoring ceased in 2019 due to inaccessibility to private land. Land was purchased by AMNS in 2020. Reinstallation of the monitoring station will occur in 2021. No discernable impacts to WL28 identified between 2016-2018.
35	No direct alteration	None to date	Commitment to commence wetland monitoring in 2021, as per the 2020 wetland monitoring annual report.
WRSA LAA			
15	0.99 ha altered associated with current Plant Access Road crossing and WRSA.	Monitoring being completed: Hydrological conditions via monitor well/data loggers. Vegetation transects General visual observations	Monitoring results indicate that wetland characteristics and function are being maintained.
17	0.02 ha altered associated with existing haul road	None to date	Initiation of monitoring was recommended to start within this wetland in 2021, as pre the 2020 annual wetland monitoring report.
53	No direct alteration	None to date	Monitoring will commence in this wetland upon EARD regulatory approval.
54	No direct alteration	None to date	Monitoring will commence in this wetland upon EARD regulatory approval.
Open Pit LAA			
22	1.70 ha altered associated with Open Pit development.	Monitoring being completed: Hydrological conditions via monitor well/data loggers. Vegetation transects General visual observations	Indirect alteration (0.06 ha) identified in the 2020 wetland monitoring annual report. Potential additional indirect alteration (drying) to a portion of WL22 in-between Open Pit and Moose River. Additional monitoring study scope is being developed with NSECC to define the indirect effects as discussed in the 2020 wetland monitoring annual report.

Table 9.14 Wetland Monitoring Conditions

WETLAND ID	DIRECT ALTERATION DETAILS	POST-CONSTRUCTION MONITORING SCOPE	POST-CONSTRUCTION MONITORING SUMMARY
27	2.68 ha altered at two locations in association with Open Pit and Scraggy Lake organics stockpile.	Monitoring being completed: Hydrological conditions via monitor well/data logger	No monitoring completed in 2019-2020 due to proposed alteration for Open Pit expansion. Plans have since been retracted and monitoring to re-commence in 2021. WL27 exhibited drier conditions on average from Year 1 (2017) to Year 2 (2018) in contrast to all other monitored wetlands which exhibited wetter conditions. Additional monitoring will increase understanding of the conditions within this wetland.
40	0.07 ha associated with bypass road construction.	Monitoring being completed: Vegetation transects General visual observations	Monitoring results indicate that wetland characteristics and function are being maintained.
49	No direct alteration	None to date	No monitoring proposed at this time. Monitoring requirements will be reviewed upon EARD regulatory approval.
56	No direct alteration	None to date	No monitoring proposed at this time. Monitoring requirements will be reviewed upon EARD regulatory approval.
Plant Access Road LAA			
32	No direct alteration	Monitoring being completed: Hydrological conditions via monitor well/data loggers. Vegetation transects	Monitoring results indicate that wetland characteristics and function are being maintained.

Wetlands of Special Significance

One occurrence of blue felt lichen was observed within the EARD LAA, in Wetland 15 (Figure 9.4, which was identified during the 2007 EARD lichen surveys and verified present by MEL in 2020.

The presence of the blue felt lichen within wetlands was not considered a trigger for classifying the wetland as a Wetland of Special Significance (WSS) during the 2007 EARD or at the time of permitting in 2015.

Currently NSECC regards the presence of the blue felt lichen in wetland habitat a trigger of WSS as per the criteria specified in the Nova Scotia Wetland Conservation Policy (NSECC 2011); *“wetlands known to support at-risk species as designated under the federal Species At Risk Act or the Nova Scotia Endangered Species Act”.* Based on the current interpretation in Nova Scotia, Wetland 15, within the WRSA expansion LAA, is identified as a WSS.

None of the remaining wetlands present within the EARD LAA are proposed for WSS designation.

Summary of Wetlands within the LAA

A total of 13 unaltered (in part or in full) wetlands are located within the current EARD LAA: three within the Clay Borrow Area expansion, four within the WRSA expansion, five within the Open Pit and one within the Plant Access Road LAA. One WSS was identified within the EARD LAA, Wetland 15, due to the presence of blue felt lichen.

Portions of some of the wetlands have been subject to partial direct alteration since 2015. Table 9.12 identifies which wetlands have been subject to direct alteration, and notes those which have been monitored since 2016 including a summary of monitoring results. Detailed wetland monitoring results are presented in the 2020 Wetland Post Construction Monitoring Report (submitted to NSECC on March 31, 2021).

9.4.2.4 Birds

Bird surveys were completed in support of the 2007 EARD. A desktop review of species observed within the LAA and 2020 AC CDC records were performed in consideration of the current EARD. An observation of a barn swallow (*Hirundo rustica*) was noted within the 2007 EARD (point count B8) and within the 2020 AC CDC next to Wetland 22, within the extent of the existing Open Pit.

Based on the habitat types observed in 2020/2021 within the current LAA, several species are likely to be encountered breeding and inhabiting these areas. The bird species presented in Table 9.6 are expected to occur within the current LAA as suitable habitat is present. Table 9.15 carries forward all SAR/SOCI bird species observed in the 2007 EARD studies and the 2020 AC CDC report. Additionally, Table 9.10 includes the vegetation types that would likely support these species.

Five SAR birds are predicted to occupy lands within the LAA based on the observed species in Section 9.4.1.3 and the vegetation and habitat types observed during 2020/2021 site assessments. These SAR species are barn swallow, Canada warbler, common nighthawk (*Chordeiles minor*), olive-sided flycatcher (*Contopus cooperi*) and Eastern wood-pewee (*Contopus virens*). These species and their suitable habitat are described in the Table 9.15 below.

Table 9.15 SAR/SOCI Birds with Elevated Potential to be Present within the LAA

Common Name	Scientific	AC CDC S-Rank	Current Status (COSEWIC, NSESA, SARA)	Associated Vegetation Type within the LAA	LAA where Vegetation Type is Present			
					WRSA Expansion	Clay Borrow Area Expansion	Plant Access Road	Open Pit
Pine Siskin	Carduelis pinus	S2S3	-	SH6 – Red Spruce – Balsam Fir / Stair-step Moss – Sphagnum SH8 – Balsam Fir / Wood Fern / Schreber's Moss SP5 – Black Spruce / Lambkill / Bracken	x	x	x	x
Purple Finch	Carpodacus purpureus	S4S5B, S3S4N	-	SH6 – Red Spruce – Balsam Fir / Stair-step Moss – Sphagnum SH8 – Balsam Fir / Wood Fern / Schreber's Moss SP5 – Black Spruce / Lambkill / Bracken	x	x	x	x
Swainson's Thrush	Catharus ustulatus	S3S4B	-	SH6 – Red Spruce – Balsam Fir / Stair-step Moss – Sphagnum SH8 – Balsam Fir / Wood Fern / Schreber's Moss SP5 – Black Spruce / Lambkill / Bracken WC2 – Black Spruce / Lambkill – Labrador Tea / Sphagnum WC6 – Balsam fir / Cinnamon fern – Three Seeded Sedge /Sphagnum	x	x	x	x
Bay-breasted Warbler	Dendroica castanea	S3S4B	-	SH6 – Red Spruce – Balsam Fir / Stair-step Moss – Sphagnum SH8 – Balsam Fir / Wood Fern / Schreber's Moss				
Barn swallow	Hirundo rustica	S2S3B	COSEWIC & SARA: Threatened; NSESA: Endangered	N/A but could be found foraging in open water features within LAA	x	-	x	x

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Table 9.15 SAR/SOCI Birds with Elevated Potential to be Present within the LAA

Common Name	Scientific	AC CDC S-Rank	Current Status (COSEWIC, NSESA, SARA)	Associated Vegetation Type within the LAA	LAA where Vegetation Type is Present			
					WRSA Expansion	Clay Borrow Area Expansion	Plant Access Road	Open Pit
Canada warbler	Cardellina canadensis	S3B	COSEWIC & SARA: Threatened; NSESA:Endangered	MH1 -Mountain Holly - Alder Swamp	x	-		x
Common nighthawk	Chordeiles minor	S2B	COSEWIC: Special Concern; SARA & NSESA: Threatened	Cutblock/clearings	x	x	x	x
Olive-side flycatcher	Contopus cooperi	S2B	COSEWIC: Special Concern; SARA & NSESA:Threatened	SH6 – Red Spruce – Balsam Fir / Stair-step Moss – Sphagnum SH8 – Balsam Fir / Wood Fern / Schreber's Moss SP5 – Black Spruce / Lambkill / Bracken WC2 – Black Spruce / Lambkill – Labrador Tea / Sphagnum WC6 – Balsam fir / Cinnamon fern – Three Seeded Sedge /Sphagnum	x	x	x	x
Eastern wood-pewee	Contpous virens	S3S4B	COSEWIC & SARA: Special Concern; NSESA: Vulnerable	SH6 – Red Spruce – Balsam Fir / Stair-step Moss – Sphagnum SH8 – Balsam Fir / Wood Fern / Schreber's Moss SP5 – Black Spruce / Lambkill / Bracken WC2 – Black Spruce / Lambkill – Labrador Tea / Sphagnum WC6 – Balsam fir / Cinnamon fern – Three Seeded Sedge /Sphagnum	x	x	x	x
Northern Harrier	Circus hudsonius	S3S4B	COSEWIC: Not at risk	Cutblock/clearings	x	x	x	x

Table 9.15 SAR/SOCI Birds with Elevated Potential to be Present within the LAA

Common Name	Scientific	AC CDC S-Rank	Current Status (COSEWIC, NSESA, SARA)	Associated Vegetation Type within the LAA	LAA where Vegetation Type is Present			
					WRSA Expansion	Clay Borrow Area Expansion	Plant Access Road	Open Pit
Pine grosbeak	Pinicola enculeator	S2S3B, S5N	-	SH6 – Red Spruce – Balsam Fir / Stair-step Moss – Sphagnum SH8 – Balsam Fir / Wood Fern / Schreber's Moss SP5 – Black Spruce / Lambkill / Bracken	x	x	x	x
Canada jay	Persioreus canadensis	S3	-	SH6 – Red Spruce – Balsam Fir / Stair-step Moss – Sphagnum SH8 – Balsam Fir / Wood Fern / Schreber's Moss SP5 – Black Spruce / Lambkill / Bracken WC2 – Black Spruce / Lambkill – Labrador Tea / Sphagnum WC6 – Balsam fir / Cinnamon fern – Three Seeded Sedge /Sphagnum	x	x	x	x
Boreal chickadee	Poecile hudsonicus	S3	-	SH6 – Red Spruce – Balsam Fir / Stair-step Moss – Sphagnum SH8 – Balsam Fir / Wood Fern / Schreber's Moss SP5 – Black Spruce / Lambkill / Bracken	x	x	x	x
Red-breast nuthatch	Sitta canadensis	S3	-	SH6 – Red Spruce – Balsam Fir / Stair-step Moss – Sphagnum SH8 – Balsam Fir / Wood Fern / Schreber's Moss SP5 – Black Spruce / Lambkill / Bracken	x	x	x	x

Table 9.15 SAR/SOCI Birds with Elevated Potential to be Present within the LAA

Common Name	Scientific	AC CDC S-Rank	Current Status (COSEWIC, NSESA, SARA)	Associated Vegetation Type within the LAA	LAA where Vegetation Type is Present			
					WRSA Expansion	Clay Borrow Area Expansion	Plant Access Road	Open Pit
Yellow-bellied flycatcher	Empidonax flaviventris	S3S4B	-	SH6 – Red Spruce – Balsam Fir / Stair-step Moss – Sphagnum SH8 – Balsam Fir / Wood Fern / Schreber's Moss SP5 – Black Spruce / Lambkill / Bracken WC2 – Black Spruce / Lambkill – Labrador Tea / Sphagnum WC6 – Balsam fir / Cinnamon fern – Three PG2 – Sweetgale	x	x	x	x
Ruby-crowned kinglet	Regulus calendula	S3S4B	-	SH6 – Red Spruce – Balsam Fir / Stair-step Moss – Sphagnum SH8 – Balsam Fir / Wood Fern / Schreber's Moss SP5 – Black Spruce / Lambkill / Bracken	x	x	x	x
Tennessee Warbler	Oreothylpis peregrina	S3S4B	-	SH6 – Red Spruce – Balsam Fir / Stair-step Moss – Sphagnum SH8 – Balsam Fir / Wood Fern / Schreber's Moss SP5 – Black Spruce / Lambkill / Bracken	x	x	x	x

Summary of Birds within the LAA

Seventeen priority bird species are predicted or potentially expected to occur within the current LAA bases on previous surveys, desktop review and the vegetation/habitat types observed. Five SAR are predicted to occupy the LAA: barn swallow (*Hirundo rustica*), Canada warbler (*Cardellina canadensis*), common nighthawk (*Chordeiles minor*), olive-sided flycatcher (*Contopus cooperi*) and Eastern wood-pewee (*Contopus virens*).

9.4.2.5 Wildlife

A desktop review of the 2020 AC CDC report found no priority wildlife observations within the Project LAA or within 5 km.

Evidence of mainland moose (Alces alces americana, NSESA Endangered), was observed during baseline surveys completed in 2004/2005 for the 2007 EARD (CRA 2007a) (Section 9.4.1.4). More recently, moose surveys have been completed as part of the Touquoy Gold Mine Project Mainland Moose Management Plan (2017). To date, three observations of moose signs (scat and tracks) were observed during 2017 surveys, and two sightings of moose tracks were observed during 2018 surveys (Figure 9.5). These observations were approximately 2-4 km from the Touquoy Mine Site. No signs of moose were observed during 2019, 2020 and 2021 surveys. However, an incidental observation of a moose on a road near the Touquoy Mine Site was reported by AMNS staff in 2019 and local residences reported moose observations in the vicinity of the Touquoy Mine Site, along Mooseland Road, in 2020.

Suitable habitat for the snapping turtle has been observed within the Touquoy Mine Site. While no turtles were observed during the 2007 EARD targeted turtle surveys there have since been incidental observations of snapping turtles in proximity to the Touquoy Mine Site, one on June 26, 2016, where the Mooseland Road section of the Haul Road crosses Fish River, and two along roadsides adjacent to the Touquoy Mine Site near Moose River and Scraggy Lake. (Figure 9.5)

No evidence of bats or suitable hibernacula have been observed since the 2007 EARD within or in proximity to the LAA.

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FIGURE 9.5

Touquoy Gold Project

2021 EARD

Priority Wildlife Observations

- Snapping Turtle Observation
- 2017 Observation of Moose Sign
- 2018 Observation of Moose Sign
- Field Delineated Watercourse
- NSECC Mapped Watercrouse
- Waterbody
- Field Delineated Wetland
- LAA (Indirect Impact Extent)
- PDA (Direct Impact Extent)
- Touquoy Mine Site Existing Footprint

Coordinate System: NAD 1983 CSRS UTM Zone 20N
Projection: Transverse Mercator
Datum: North American 1983 CSRS
Units: Meter

0 270 540 1,080 m

1:22,000 Scale when printed @ 11" x 17"

Drawn By: SS
Reviewed By: MM
Date: 2021-06-25

McCallum Environmental Ltd.

Document Name: 210602_TQ EA_PriorityWildlife

9.5 PROJECT INTERACTIONS WITH THE TERRESTRIAL ENVIRONMENT

Project activities that might interact with the terrestrial environment for each potential effect are identified in Table 9.16.

Table 9.16 Project Interactions with Terrestrial Environment

Project Components and Activities	Change In		
	Vegetation and Vegetation Communities including Priority Species	Wetland Habitat	Wildlife including Priority Species
In-Pit Tailings Disposal			
Realignment of Tailings Line from TMF			
Deposition/Disposal of Tailings (operation of the Open Pit for tailings disposal)		X	X
Water Management (will differ in different stages)			
Reclamation and Decommissioning			
WRSA Expansion			
Site Preparation	X	X	X
Operation of the WRSA	X	X	X
Water Management (e.g., modification of water drainage structures; new settling pond, relocation of monitoring well)	X	X	X
Reclamation and Decommissioning	X		X
Clay Borrow Area Expansion			
Site Preparation	X	X	X
Operation of Borrow Area	X	X	X
Water Management		X	
Reclamation and Decommissioning	X		X
Plant Access Road			
Site Preparation	X	X	X
Operation of Plant Access Road for Site Traffic	X		X
Reclamation and Decommissioning	X	X	X

9.5.1 Change in Vegetation and Vegetation Communities including Priority Species

The Project activities as described in Table 9.16 will result in the following interactions with vegetation and vegetation communities. The realignment of the tailing line will occur within the existing Touquoy Mine Site operational footprint. As a result, no interactions with in-pit disposal are expected.

- Direct loss of habitat and vegetation communities are expected within all PDAs as result of clearing, except for the in-pit disposal.
- Direct loss of lichen SOCI within the WRSA expansion PDA is expected because of clearing. There are no direct impacts expected to observed SAR lichen in any PDAs. No priority vascular flora species were observed within the PDAs.
- Indirect impact to adjacent habitats, vegetation communities and vascular/non-vascular SAR or SOCI are expected from edge effects of clearing and project development and associated potential dust deposition.
- Direct impacts to interior forest and indirect impacts from edge effects are expected to be low as the PDAs and surrounding LAA have largely been affected by previous disturbances, such as historic mining and timber harvesting. The LAA are dominated by cutover and early to mid-successional forested communities, which commonly develop after timber harvesting and other disturbances (Neily et al. 2010).
- Habitat fragmentation is expected to be low as PDAs are directly adjacent to existing development areas at the Touquoy Mine Site.

9.5.2 Change in Wetland Habitat

The Project activities as described in Table 9.16 will result in the following interactions with wetland habitat. The realignment of the tailings line will occur within the existing Touquoy Mine Site operational footprint. As a result, no direct wetland impacts are expected from in-pit disposal. Indirect impacts specific to in-pit disposal are noted.

- Direct loss of wetland habitat because of the WRSA expansion Clay Borrow Area and Plant Access Road PDAs.
- Indirect impact to wetland hydrology associated with water management systems for site contact water collection are expected at the WRSA expansion and Clay Borrow Area expansion PDAs.
- Groundwater seepage from the WRSA expansion and Open Pit PDAs may affect water quality in wetland habitat.
- A change in hydrology (water quantity) in riparian wetlands along the Moose River may occur during post-closure because of Open Pit filling and discharge.

9.5.3 Change in Wildlife including Priority Species

The Project activities as described in Table 9.16 will result in the following interactions with wildlife and priority species. Those that are only specific to in-pit disposal are noted.

- Direct loss of habitat that supports wildlife, including SAR and SOCI, is expected within all PDAs as result of clearing, except for the in-pit disposal (realignment of the tailing line will occur within the existing Touquoy Mine Site operational footprint).

- The following indirect impacts to wildlife, including SAR and SOCI, are expected because of development:
  - Sensory disturbance (noise and light);
  - Disturbance and/or displacement because of edge effects, and;
  - Dust deposition.
- Direct loss of wildlife (mortality) due to vehicle collisions, human-wildlife interactions, or entrainment in the Open Pit
- Effects to wildlife because of impacts to interior forest and habitat fragmentation are expected to be low as described in Section 9.5.1.

9.6 MITIGATION

In addition to the standard management and monitoring procedures applied at site, as discussed in Section 4.0, the following specific measures will be implemented to reduce or eliminate adverse effects on the terrestrial environment:

- Project infrastructure has been micro-sited to the extent possible to avoid all observed SAR and SOCI lichen occurrences, except for one red beard lichen occurrence within the proposed WRSA expansion PDA.
- Intact forest stands and wetlands will be avoided wherever practicable during detailed Project planning and design in favor of previously disturbed areas (e.g., stands disturbed by timber harvesting, roads, or other development). Where natural, intact habitat cannot be avoided, maintain existing vegetation cover whenever practicable and minimize overall areas of disturbance.
- A wetland alteration application will be submitted prior to construction to request an authorization to alter wetland habitat and to address loss of wetland function.
- Provide wildlife awareness training to site personnel to reduce interactions between site personnel and wildlife.
- A speed limit of 40 km/hr within the Touquoy Mine Site has already been implemented to reduce likelihood of collisions with wildlife. Signage will be installed where specific wildlife concerns have been identified. Vehicles will yield to wildlife on roads. This speed limit and signage will be extended to include the proposed Plant Access Road and any other smaller roads associated with the Project.
- Monitor and manage road conditions through dust suppression and traction control (sand on icy roads) to reduce potential for collisions with wildlife.
- Follow the Pit and Quarry Guidelines to reduce the impact of noise and vibration on wildlife.
- Limit use of lights to the amount necessary for safe operation within the Touquoy Mine Site, with the recognition that excessive lighting can be disruptive to wildlife. Additional lighting will be installed facing downward and wherever practicable using motion-sensing lights.
- Discourage ground- or burrow-nesting species (particularly common nighthawk), by limiting the amount of exposed soil.
- 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. Culverts will be installed in accordance with the *Watercourse Alterations Standard* and NSECC approval.

- A deterrent system will be considered at the Touquoy Mine Site for the in-pit tailings disposal, like the existing deterrents currently used at the TMF. This will deter wildlife from using the Open Pit during and after filling which may have deleterious effects resulting from long-term exposure.

The following plans and programs will be developed, updated as required and/or continue to be implemented to mitigate impacts to the terrestrial environment:

- Environmental Protection Plan (EPP) (SD 1) – The EPP provides a single reference document to facilitate field implementation of permit and regulatory requirements and reduce the impact of the Project on the environment and surrounding communities.
- Environmental Effects Monitoring Plan for Operation
  - *Wetland Protection Plan* - This plan was completed in adherence with Condition 6.2 of the EA Approval. The purpose of the Wetland Protection Plan is to provide an overview of methods by which wetlands existing within the Touquoy Mine Site, adjacent to the development area and down-gradient of the development area are protected.
  - *Wetland Compensation Plan* - Annual surveys of the Touquoy Mine Site will be completed to identify and update areas disturbed because of Project related activities. Compensation for permanent loss of wetland function will be completed through wetland restoration activities to support no net loss of wetland function, subject to NSECC approval.
  - *Wildlife Management Plan (WMP) (SD 8)* – The WMP was submitted January 27, 2017 to satisfy Condition 5.4 of the EA Approval and to guide monitoring and management of wildlife at the Project. The purpose of the WMP is to outline protocols to reduce interactions between terrestrial wildlife and Project activities.
  - *Mainland Moose Management Plan (MMMP)* – The MMMP was submitted January 26, 2017 to satisfy Condition 5.2 of the EA Approval. The purpose of the MMMP is to outline protocols to monitor usage of the Touquoy Mine Site and surrounding landscape by mainland moose, minimization of moose-human interaction, and support research, education and stewardship related to mainland moose recovery.

- Lichen Monitoring Plan – A lichen monitoring program will be developed to monitor for possible indirect impacts to observed lichen SAR within the operational footprint of the Touquoy Mine Site. The plan will consider the impacts of edge effects and dust/particulate deposition on lichens from proposed expansion activities as described within this EARD.
- Wetland Monitoring Plan – An ongoing annual wetland monitoring program has been implemented at the Touquoy Mine Site. All wetlands expected to be directly or indirectly impacted within the LAA are included, or will be proposed, as part of this program. The current monitoring plan will be reviewed in the content of this EARD and modified as necessary (e.g., level of effort, monitoring location) because of the new Project activities and interactions.
- Reclamation Plan (SD 6)– This plan will aim to restore natural habitat and food sources within the Touquoy Mine Site upon closure to support vegetation and wildlife re-establishment.
- Sediment and Erosion Control Plan (SD 2) – This plan will be implemented so site runoff is not directed towards unaltered habitat.
- Spill Contingency Plan - This plan will be implemented to protect wildlife and their habitats from accidental spills.

9.7 ASSESSMENT OF RESIDUAL EFFECTS

9.7.1 Change in Vegetation and Vegetation Communities including Priority Species

No additional clearing or direct habitat interactions are expected within the Open Pit LAA as a result of in-pit tailings disposal. The realignment of the tailing line will occur within the existing Touquoy Mine Site operational footprint.

The PDAs will predominantly directly impact the Spruce Hemlock Forest Group (SH8) vegetation community, as well as previously cutover areas. The Spruce Pine Forest Group (SP5) and Intolerant Hardwood Forest Group (IH6) will also be directly impacted by the WRSA expansion and Clay Borrow Area expansion PDA respectively. Wetland communities WC5 and MH1 will be directly impacted by the WRSA expansion PDA. Direct impact area by vegetation type is presented in Table 9.17.

Table 9.17 Direct impacts to Vegetation Communities

Vegetation Type	LAA	PDA Direct Impact area (ha)	Total Impact per Vegetation Type
Upland Communities			
SH6 – Red Spruce – Balsam Fir / Stair-step Moss - Sphagnum	Clay Borrow Area Expansion	0	No direct impact.
	WRSA Expansion	0	
	Plant Access Road	0	
SH8 – Balsam Fir / Wood Fern / Schreber's Moss	Clay Borrow Area Expansion	5.43	10.98 ha
	WRSA Expansion	4.06	
	Plant Access Road	1.49	
SP5 – Black Spruce / Lambkill / Bracken Fern	Clay Borrow Area Expansion	0	2.03 ha
	WRSA Expansion	2.03	
	Plant Access Road	0	
IH6 – White Birch – Red Maple / Sarsaparilla – Bracken Fern	Clay Borrow Area Expansion	0.53	0.53 ha
	WRSA Expansion	0	
	Plant Access Road	0	
Cutover	Clay Borrow Area Expansion	0	3.16 ha
	WRSA Expansion	1.32	
	Plant Access Road	1.84	
Wetland Communities			
WC2 – Black Spruce / Lambkill – Labrador tea / Sphagnum Moss	Clay Borrow Area Expansion	0	No direct impact.
	WRSA Expansion	0	
	Plant Access Road	0	

Table 9.17 Direct impacts to Vegetation Communities

Vegetation Type	LAA	PDA Direct Impact area (ha)	Total Impact per Vegetation Type
WC6 – Balsam Fir / Cinnamon Fern – Three Seeded Sedge / Sphagnum Moss	Clay Borrow Area Expansion	0	0.76 ha (Wetland 15 and 17)
	WRSA Expansion	0.76	
	Plant Access Road	0	
PG2 - Sweetgale Mixed Shrub Fen	Clay Borrow Area Expansion	0	No direct impact.
	WRSA Expansion	0	
	Plant Access Road	0	
MH1 - Mountain Holly – Alder Shrub Swamp	Clay Borrow Area Expansion	0	0.22 ha (Wetland 15)
	WRSA Expansion	0.22	
	Plant Access Road	0	
Total Impact Area		17.68 ha	

Based on the direct impacts presented in Table 9.17 and the habitats present within the surrounding landscape, the direct impacts to vegetation communities in a regional context because of this Project an expected to be low. The impacted vegetation communities are commonly found within the Eastern Interior (440) Ecodistrict in Nova Scotia (4575 km2). The Eastern Interior Ecodistrict is dominated (50%) by the Spruce Hemlock Forest Group, and to a lesser extent, the Spruce Pine Forest Group (28%). Natural (e.g., fire, hurricanes) and anthropogenic (e.g., timber harvesting) disturbance are common within this Ecodistrict. Intolerant hardwood stands are commonly found within the resultant early successional forests (NSDNR 2017). Much of the habitat proposed for alteration currently exists in a disturbed and fragmented condition (e.g., cutover, regenerating stands) due to ongoing and historic mine operation, road and trail networks, and current and historic forestry activity.

One occurrence of red beard lichen is within the WRSA expansion PDA and is expected to be directly impacted because of the Project (Figure 9.4). Impacts to this occurrence could not be avoided through detailed Project design. The specimen will be collected prior to development and submitted to the E.C. Smith Herbarium located at the Acadia University, Wolfville, Nova Scotia.

One occurrence of corrugated shingles lichen, one occurrence of crumpled bat’s wing lichen and two occurrences of red beard lichen are within 60 m of the PDAs, and as a result may be indirectly impacted by Project activities. Due to their non-vascular physiology, lichens are especially sensitive to changing environmental conditions, particularly air quality and edge effects (Boudreault et al. 2008). Studies have shown that distance in which lichens are affected by edge effects (referred to as depth of influence) is species and context-dependent (e.g. dependent on size of the clearings, substrate, type of climate.). For pendent fruticose lichens (Renhorn et al. 1996) and diversity of cyanolichens (Haughian and Harper 2020) this distance can range from 60 to 80 m, respectively. However, studies by Gauslaa et al. (2018) recommend setbacks of greater than 240 m for three Lobaria species studied in temperate rainforests of British Columbia. Additionally, changes in vegetation communities that support lichen species could affect lichen community health and abundance (Cornelissen et al. 2001).

Dust deposition may result in increased alkalinity in substrate pH composition (e.g., bark of host tree) and bioaccumulation in lichen tissue which can impact lichen health and species richness (Degtjarenko, 2016; Naeth and Wilkinson 2008; Farmer, 1993). Farmer (1993) observed species decline at dust deposition levels of 1.0-2.5 g/m2/day. Effects to lichens were still observed at levels 0.07 g/m2/day. Given the primary use of the Plant Access Road (vehicle travel), the impacts of dust deposition on lichen may be elevated in this area. While the Plant Access Road has been micro-sited to avoid the occurrence of red beard lichen, the lichen will be within 10 m of the PDA and may be indirectly impacted by edge effects and dust deposition.

Other priority lichen species within the LAA are over 75 m from the PDA (Figure 9.4), or they were not observed in 2020/2021 and are no longer extant (i.e., WRSA expansion). These occurrences are not expected to be impacted by edge effects; however, they may still be exposed to the effects of fugitive dust deposition.

Wetland 15, which has one blue felt lichen occurrence (SAR), is expected to be partially altered by the WRSA expansion (Figure 9.4). However, the blue felt lichen occurrence is over 125 m from the PDA, on the western wide of Watercourse #4 and is therefore not expected to be indirectly impacted by the edge effects. Due to the proximity of the occurrences to existing mine developments (~50 m), it is not expected that new Project activities because of this EARD (waste rock storage) will further impact this occurrence of blue felt lichen through dust deposition.

With mitigation and environmental protection measures, the residual effect of a change in vegetation and vegetation community is predicted to be not significant. The direct loss of habitat and flora will be largely confined to areas with previous disturbance and will be partially mitigated through site reclamation. Direct impacts to priority lichen will be mitigated through species collection prior to development and indirect impacts to priority lichen will be monitored through the proposed Lichen Monitoring Plan (Section 1.6).

9.7.2 Change in Wetland Habitat

No additional clearing or direct wetland interactions are expected within the Open Pit LAA because of in-pit tailings disposal. The realignment of the tailing line will occur within the existing Touquoy Mine Site operational footprint. As a result, no direct wetland impacts are expected from in-pit disposal.

Riparian wetlands along the Moose River west of the Open Pit, and wetlands located south of the Open Pit within the LAA may be affected by direct groundwater seepage discharge during Open Pit re-filling because of tailings deposition. The quality of this groundwater seepage has been predicted to support this EARD and presented in Appendix D.1 (Stantec 2021b). This modelling effort has predicted that groundwater seepage may discharge to surface water and wetlands within the defined LAA including WL22, WL27, WL40, WL49 and WL56. The predicted water quality of this seepage is at concentrations that comply with regulatory guidelines protection of aquatic health, per the IA criteria and thus, there is no predicted residual impact to wetland habitat (water quality) from deposition of tailings in the exhausted Open Pit

No wetlands will be completely altered because of the Project. Two wetlands, Wetland 15 and 17, will be partially altered. The remaining portions of Wetlands 15 and 17 are expected to be large enough to remain self-sufficient and retain their baseline hydrological and ecological function and therefore, are not expected to result in complete alterations. Table 9.18 presents the estimated direct impact areas and potential indirect impacts to wetlands because of the Project. Direct impact areas presented herein are for the proposed Project only and are in addition to the existing impacts as a result of the operating Touquoy Mine Site.

Table 9.18 Direct and Potential Indirect Impacts to Wetlands

Wetland ID	LAA	Total Area (ha)	Estimated Direct Impact area (ha)	Percent Alteration	Potential Indirect Impact
6	Clay Borrow Area Expansion	11.45	0	0%	None expected. Included in monitoring program.
28	Clay Borrow Area Expansion	0.85	0	0%	None expected. Included in monitoring program between 2016-2018. Monitoring is planned to continue in 2021.
35	Clay Borrow Area Expansion	0.28	0	0%	None expected. Commitment to commence wetland monitoring in 2021.
15	WRSA Expansion	9.55	0.62	6.5%	None expected. Included in monitoring program.
17	WRSA Expansion	0.61	0.37	60.6%	None expected. Commitment to commence wetland monitoring in 2021.
53	WRSA Expansion	0.08	0	0%	None expected. No monitoring planned at this time.
54	WRSA Expansion	0.21	0	0%	None expected. No monitoring planned at this time.
22	Open Pit	12.63	0	0%	Indirect alteration (0.06 ha, drying) identified in the 2020 wetland monitoring annual report associated with the Approved Project impacts. Additional monitoring scope to be defined. No indirect impacts are expected from this EARD. No monitoring planned at this time.
27	Open Pit	4.90	0	0%	None expected. No monitoring completed in 2019-2020 due to proposed alteration for pit expansion. Monitoring to re-commence in 2021.
40	Open Pit	0.75	0	0%	None expected. Included in monitoring program.

Table 9.18 Direct and Potential Indirect Impacts to Wetlands

Wetland ID	LAA	Total Area (ha)	Estimated Direct Impact area (ha)	Percent Alteration	Potential Indirect Impact
49	Open Pit	0.04	0	0%	None expected. No monitoring planned at this time. .
56	Open Pit	0.17	0	0%	None expected. No monitoring planned at this time.

Infrastructure has been planned to avoid wetland impacts wherever practicable and considering other environmental and engineering constraints. During the wetland alteration permitting phase, additional micro-siting of infrastructure (i.e., Plant Access Road or pond alignment) may occur where practicable to further avoid wetland impacts.

Impacted portions of Wetlands 15 and 17 are classified as tree and shrub swamps (WC6 and MH1). While potential fish habitat was noted within Wetland 15 as part of the functional assessment (Table 9.5), no contiguous fish habitat will be directly impacted by the PDA. The priority bird species expected to be present within the LAA that might utilize the WC6 habitat, primarily for foraging, include Swainson's thrush, olive-sided flycatcher, Eastern wood-pewee, yellow-bellied flycatcher, and Canada jay. The MH1 vegetation community contains potential Canada Warbler breeding habitat and is discussed further in Section 9.7.3.

Monitoring is currently occurring or planned for Wetlands 15 and 17 because of existing direct or potential indirect effects from the operating Touquoy Mine Site. With respect to wetlands within the Open Pit LAA (i.e., Wetlands 22, 27, 40, 49 ad 56), it is not expected that this Project will exacerbate the observed potential changes stemming from operational groundwater drawdown in the Open Pit associated with the operational mine. Therefore, no additional monitoring is proposed for these wetlands.

At post closure and once water quality in the Touquoy Mine Site Open Pit meets MDMER discharge criteria, water surplus will be released into Moose River via a spillway. The spillway is proposed to be installed at an elevation of 108 m to prevent the Open Pit from overtopping. The predicted increase in flow from both Open Pit overflow and groundwater seepage is expected to be low (<4%) of the average August Moose River flow (when flows are lowest). No indirect impacts to Wetlands 56 are expected from this minor increase in flow.

As described in Section 9.4.2.3, Wetland 15 was identified as a WSS due to the presence of blue felt lichen. Wetland 15 has already been impacted by the existing WRSA. The new proposed impact area within Wetland 15 does not contain occurrences of blue felt lichen. No wetland alteration is planned to support this Project within 125 m of this occurrence.

With mitigation and environmental protection measures, the residual effect of a change in wetland habitat is predicted to be not significant. The habitat provided by the impacted wetland areas is common and abundant within the region and RAA. No direct impact to fish habitat within Wetland 15 is expected to occur because of this Project. Direct and indirect impacts to wetlands will be mitigated through the protection, compensation, and monitoring plans outlined in Section 9.6.

9.7.3 Change in Wildlife including Priority Species

As presented in Table 9.17, the Project will result in direct impacts to habitats, including those which support observed priority wildlife and bird species.

The majority of the direct habitat impacts are within the SH8 vegetation community (62%). The SH8 vegetation type is associated with historical disturbances which is reflective of the even-aged stand and poorly developed herbaceous layer. The regenerative portions of this vegetation type may provide suitable habitat for refuge and foraging for hare and for mainland moose and passerine bird species. The SP6 and IH6 vegetation types represent 11% and 3% of the impact area respectively, and support foraging and breeding habitat for passerine bird species and small mammals.

The Project will result in a small additional loss of habitat that supports moose foraging activities. This habitat is predominantly the regenerative SH8 vegetation community in the eastern and southern portions of the LAA (Table 9.17). These areas exist within the operational Touquoy Mine Site and as a result of the presence of the operating mine, impacts to these areas are not expected to result in further changes to moose habitat use and patterns. As described in Section 9.7.1, the Spruce Hemlock Forest Group is abundant within the region and exists in large patches beyond the Touquoy Mine Site. As observed during moose surveys (Section 9.4.2.5), the surrounding landscape has the capacity to provide suitable mainland moose habitat.

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 (>50 cm) to prevent freezing through during the winter, with a mucky or muddy substrate (ECCC 2020). 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 (ECCC 2020). 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. While no additional habitat loss is expected for herpetile species, particularly snapping turtle which have been observed at the Touquoy Mine Site, Project developments will provide additional nesting habitat, such as along the new Plant Access Road, and resultant associated risk with snapping turtle interactions. The associated risks of habitat creation will be considered during operational wildlife management and mitigation (Section 9.6).

Habitats which support the five observed or predicted avian SAR (common nighthawk, Canada warbler, barn swallow, olive-sided flycatcher, and eastern wood-pewee) will be lost by the direct impact of the Project. The SH8, SP5 and IH6 vegetation communities with anticipated direct impacts provide foraging habitats for passerine avian SAR bird. The MH1 vegetation community, which has the potential to support Canada warbler breeding habitat, was identified within the impacted portion of Wetland 15. The WRSA expansion PDA is expected to impact ~0.2 ha of this habitat, equal to 1% of total habitat impact area. The SH8, SP5 and IH6 vegetation communities are abundant within the larger Eastern Interior Ecodistrict (Section 9.7.1) and landscape surrounding the Project. Wetlands with well-developed shrub layers, such as the MH1 vegetation type, are also widespread throughout the Ecodistrict and Nova Scotia. Due to the abundance of these habitats regionally and the likely decreased quality of the impacted habitats because of their proximity to the operating Touquoy Mine Site, it is not expected that this Project will further impact avian SAR.

Some priority bird species may be attracted to the Project infrastructure and newly created habitat. The common nighthawk, for instance, nests on exposed soils and disturbed areas and Project activities may increase habitat suitability for this species. As barn swallows commonly nest in anthropogenic structures, the Project activities associated with this EARD are not anticipated to create additional barn swallow habitat. The associated risks of habitat creation should be considered during operational wildlife management and mitigation (Section 9.6)

Indirect effects to wildlife (i.e., vehicle interactions, edge effects, sensory disturbance) are not expected to increase beyond those associated with the current operation of the Touquoy Mine site. The development and use of the Plant Access Road may provide additional opportunities for vehicle-wildlife interactions. Mitigation will be employed to reduce this risk (i.e., appropriate speed limits, signage, proper road maintenance).

With mitigation and environmental protection measures, the residual effect of change in wildlife, including priority species, resulting from the Project is predicted to be not significant. The habitat provided by the impacted areas is common throughout the Eastern Interior Ecodistrict (Section 9.7.1), which encompasses the RAA, and will be partially mitigated through site reclamation. Additionally, much of the impact areas have been previously disturbed and do not provide high quality habitat for the observed species (i.e., cutover forest). Direct and indirect impacts to wildlife will be mitigated through the management and monitoring plans outlined in Section 9.6.

9.8 FOLLOW-UP AND MONITORING

Monitoring of the terrestrial environment will be completed to verify the accuracy of the predicted environmental effects and the effectiveness of the mitigation measures. Specific management and monitoring plans are presented in Section 9.6.

Wetlands are protected under the provincial *Environment Act* and an approval is required for alteration. Wetland alteration applications will be submitted and permitting will be obtained prior to any construction in a wetland. Wetlands altered by the Project will be compensated at the ratio determined in the Wetland Compensation Plan (Appendix E.2) in consultation with NSECC. AMNS will continue to work with NSECC to develop the required mitigation measures including wetland compensation to mitigate any loss of wetland habitat based on function and relative value.

10.0 CULTURAL AND HERITAGE RESOURCES

Cultural and Heritage Resources include sites, materials, and places of historical, archaeological, cultural, spiritual, paleontological, and architectural importance. Cultural and heritage resources can originate in the distant past, pre contact, historic or contemporary periods dependent on the inherent or recognized value for their cultural, spiritual, natural, or scientific importance.

Cultural and heritage resources have been identified as a VC because they provide physical information on Indigenous lifestyles prior to the arrival of Europeans in North America and help to provide insight into the interactions that occurred between cultural groups and their connection to the land and environment in which they lived. The assessment of cultural and heritage resources also includes potential Project interactions with components of historical, educational, cultural, or spiritual importance.

The cultural and heritage potential at the Touquoy Mine Site has been evaluated on several occasions (Section 9.4). This evaluation of effects on cultural and heritage resources considers results of previous impact assessments, as applicable, as well as recent work undertaken specifically to investigate new potential interactions specific to proposed Project activities.

10.1 POTENTIAL EFFECTS, PATHWAYS AND MEASURABLE PARAMETERS

Table 10.1 lists potential effects on cultural and heritage resources and provides a summary of the Project effect pathways and measurable parameters to assess potential effects. Potential environmental effects and measurable parameters were selected based on review of recent EAs for similar projects in Nova Scotia and other parts of Canada, and professional judgment.

Table 10.1 Potential Effects, Effects Pathways and Measurable Parameters for Cultural and Heritage Resources

Potential Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Loss of information about or disturbance to cultural and heritage resource(s) and their context	• Project interactions whereby physical works result in the disturbance or destruction of cultural and heritage resources	• Significance of the cultural and heritage resources affected in the PDA and LAA • Integrity of historic resource site(s) in the PDA and LAA

10.2 BOUNDARIES

The scope of assessment has been defined by the geographical extent of potential effects and the timing of potential effects. The spatial boundaries for cultural and heritage resources have been selected in consideration of the geographic extent over which Project activities and their effects are likely to occur and in consideration of the spatial boundaries used in previous ARIAs and the Mi’kmaq Knowledge Study.

Temporal boundaries are based on the timing and duration of Project activities and the nature of the interactions between project activities and the VC. The spatial and temporal boundaries associated with the effects assessment for the cultural and heritage resources are described in the following sections.

10.2.1 Spatial Boundaries

- Project Development Area (PDA): The PDA represents the anticipated area of direct physical disturbance associated with construction, operation and decommissioning of the Project. It comprises the existing Open Pit, WRSA expansion, new Clay Borrow Area, the RoW of the relocated Plant Access Road, and area required for ancillary features associated with these Project components (e.g., ditching, monitoring wells, parking lot security guard house).
- Local Assessment Area (LAA) The LAA for cultural and heritage resources includes the PDA as well as the extent of the AMNS mineral claim area. The LAA includes the study area subjected to archaeological screening prior development of the Approved Project.
- Regional Assessment Area (RAA): The RAA incorporates the PDA and LAA and the Musquodoboit Valley and Shubenacadie region, located in the Mi’kmaq district of Sipekne’katik. The RAA was selected in consideration of the study area for a Mi’kmaq Knowledge Study (CMM 2005) undertaken for the Approved Project and is intended to provide a regional context for the prediction of archaeological resource potential within the LAA and PDA.

10.2.2 Temporal Boundaries

The temporal boundaries for the assessment of effects on cultural and heritage resources include the construction phase, operation phase, and closure phase, which includes the decommissioning and reclamation stage, and post-closure stage; the project schedule is provided in Section 2.5. A loss of extant archeological resources is considered to be permanent.

10.3 SIGNIFICANCE DEFINITION

A significant adverse residual effect on cultural and heritage resources is a Project-related effect which results in the unauthorized disturbance or destruction of an archaeologically, culturally, or historically significant resource which cannot be mitigated.

10.4 BASELINE CONDITIONS

Since 2005, there have been several ARIAs conducted by Cultural Resource Management Group (CRM Group) and Mi’kmaq Environmental Services in the Moose River Gold Mine area, in relation to the redevelopment of the Touquoy Mine:

- Mi’kmaq Knowledge Study – Touquoy Gold Project (Mi’kmaq Environmental Services 2005)
- Touquoy Gold Project Archaeological Resource Impact Assessment (CRM Group 2005)
- Touquoy Gold Project: Archaeological Screening (CRM Group 2006)
- Touquoy Gold Project: Moose River Heritage Preservation (CRM Group 2008)
- Touquoy Gold Project Archaeological Resource Impact Assessment (CRM Group 2021)

The previous ARIA Study Boundaries and Buffers Relative to Proposed Modifications are available in Figure 10.1.

The initial pre-development assessment in 2005 (conducted according to the terms of Category “C” Heritage Research Permit A2005NS42), identified surviving historic roads, trails, mine pits, shafts, houses, and outbuildings associated with the Moose River Gold Mine, established in 1866. These extant features were determined to be too modern to have archaeological components and the study area was determined to be of low archaeological potential (CRM Group 2021).

In addition to the ARIA, a Mi’kmaq Knowledge Study (MKS) was also commissioned in 2005 to evaluate the cultural and heritage resources in the Musquodoboit Valley and Shubenacadie region to inform planning for the Touquoy Mine Site The MKS included the study of current and historic Mi’kmaq Land and resource use, evaluated the potential impact and significance of project activities, and made recommendations to proponents and regulators for mitigation measures. The MKS also recommended further study or consultation with Mi’kmaq, where necessary (CMM 2005). The MKS concluded that historic land use occurred pre- and post-contact in the region and is ongoing with Mi’kmaq using the region for hunting, collecting of medicinal plants, ceremonial purposes, gathering or habitation purposes. The MKS also recommended that in the event Mi’kmaq archeological deposits are encountered during construction or operation of the project that work should be halted, and contact should be made with the Special Places Program. If finds are of a Mi’kmaq context, the Kwilmu'kw Maw-klusuaqn Negotiation Office (https://mikmaqrights.com/), the Confederacy of Mainland Mi’kmaq (http://cmmns.com/), or the nearest Mi’kmaw community should be contacted

As development plans for the Touquoy Mine Site evolved and new potential areas of disturbance were identified, CRM Group conducted a new ARIA evaluating the areas outside the 2005 study area. The 2006 assessment was conducted according to terms of Category “C” Heritage Research Permit A2006NS60. This ARIA recommended that no ground disturbance occur within 50 metres of Moose River or Square Lake without prior sub-surface testing. It also recommended archaeological clearance of the remaining study area due to low archaeological potential (CRM Group 2021).

In 2008, CRM Group was retained by AMNS to prepare a Moose River Heritage Preservation Plan with the objective of preserving the cultural heritage of Moose River Gold Mines and providing a mechanism to educate the public about modern mining practices.

In the spring of 2021 CRM Group was retained by AMNS to undertake an ARIA to assess the potential for encountering cultural resources prior to any development-related ground disturbances associated with the proposed expansion of the WRSA and Clay Borrow Area. Approximately 0.27 ha of the proposed expansion area of the WRSA lies within the previously assigned 50-metre buffer zone of Square Lake (thereby requiring shovel testing prior to disturbance) and a portion of the Clay Borrow Area expansion lies outside the study areas assessed and cleared by previous ARIAs.

The current ARIA available in Appendix C.1 was conducted according to the terms of Category “C” Heritage Research Permit A2021NS053 and included a background study, Mi’kmaq engagement, archaeological reconnaissance, and archaeological shovel testing. A total of 103 shovel test excavations were completed; 102 tests within the proposed WRSA development area and 1 within the proposed Clay Borrow Area development area. Of the 103 tests, no positive tests were encountered, and no anomalies indicative of buried archaeological resources were observed. The ARIA acknowledged that the Clay Borrow Area is comprised of rocky, wet, and sloped terrain and ascribed the area as having low archaeological potential.

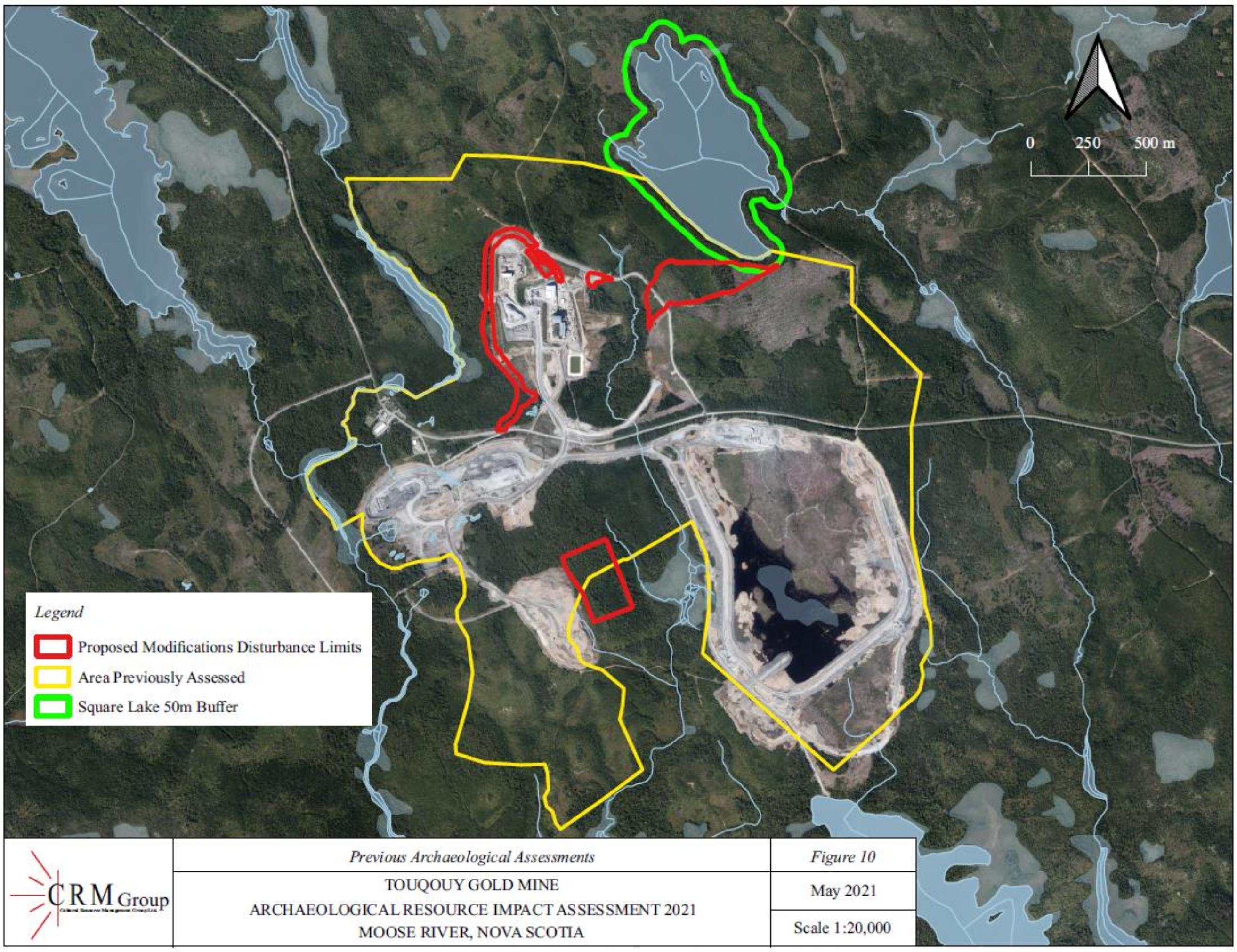

Figure 10.1: Previous ARIA Study Boundaries and Buffers Relative to Proposed Modifications

10.5 PROJECT INTERACTIONS WITH CULTURAL AND HERITAGE RESOURCES

Project activities that might interact with cultural and heritage resources for each potential effect are identified in Table 10.2.

Table 10.2 Project Interactions with Cultural and Heritage Resources

Project Activities	Loss or disturbance to cultural and heritage resources
In-Pit Tailings Disposal	
Deposition/Disposal of Tailings	
Water Management	X
Reclamation and Decommissioning	
Waste Rock Storage Area Expansion	
Site Preparation	X
Operation of the WRSA	
Water Management (e.g., modification of water drainage structures; relocation of monitoring well)	X
Reclamation and Decommissioning	
Clay Borrow Area	
Site Preparation	X
Operation of Clay Borrow Area	X
Water Management	X
Reclamation and Decommissioning	
New Plant Access Road	
Site Preparation	X
Operation of Road for Site Traffic	
Reclamation and Decommissioning	

Although several ARIAs undertaken in relation to the Touquoy Gold Project have determined the Mine Site has low archaeological potential (CRM Group 2005, 2006, 2021), except for a 50 m buffer zone around Square Lake which has elevated archaeological potential (CRM Group 2006), any Project-related activity involving ground disturbance has the potential to interact with previously undiscovered cultural and heritage resources. This includes excavation associated with the installation of water management features for the Open Pit, WRSA and Clay Borrow Area, ongoing operation of the Clay Borrow Area, and site preparation for the WRSA and new Plant Access Road. Except for the Clay Borrow Area (where continued use requires ongoing surface disturbance), no Project interactions are predicted after construction/site preparation.

10.6 MITIGATION

The following mitigation measures, which are based on relevant recommendations from previous ARIAs (CRM Group 2005, 2006, 2008) and preliminary recommendations from the most recent ARIA (CRM Group 2021), will be implemented to reduce or eliminate adverse effects on cultural and heritage resources:

- If any further changes are made to the layout of the Touquoy Mine Site beyond the area of previous ARIAs, those areas will be subject to an updated ARIA prior to disturbance.
- No ground disturbance will occur within 50 metres of Moose River or Square Lake (outside the study area evaluated in the 2021 ARIA) without additional archaeological assessment, including shovel testing.
- Historical resources related to European occupation unintentionally discovered during Project activities will be provided to the Moose River Museum for curating.
- If an archaeological site is encountered or suspected during work the following measures will be taken to protect the feature(s) from damage:
- Stop all work in the area as to not further disturb the site, isolate, and protect the area.
- Report the discovery to supervisors and AMNS' Environment Department Representative who will contact the Special Places Program. If finds are of a Mi'kmaq context, the Kwilmu'kw Maw-klusuaqn Negotiation Office (https://mikmaqrights.com/), the Confederacy of Mainland Mi'kmaq (http://cmmns.com/), or the nearest Mi'kmaw community will be contacted
- Note the location and leave all discoveries in place

Work will not recommence until permissions has been given to proceed by the Special Places Program.

10.7 ASSESSMENT OF RESIDUAL EFFECTS

10.7.1 Loss or Disturbance of Cultural and Heritage Resources

Installation of conveyance systems associated with the in-pit tailings disposal will result in ground disturbance, although this work will occur within areas previously subjected to ARIAs which have determined the potential for encountering archaeological resources is low. With the implementation of mitigation and contingency measures as outlined above, the residual effect on cultural and heritage resources from in-pit tailings disposal is predicted to be negligible.

Expansion of the WRSA will occur in an area previously determined to have elevated archaeological potential, given its proximity to Square Lake. Site preparation and installation of water management infrastructure (e.g., sediment pond) associated with this Project component will require ground disturbance, thereby having the potential to interact with cultural and heritage resources that may be present. Approximately 0.27 ha of proposed WRSA development occurs within the Square Lake 50 m buffer. However, this specific area was the focus of a recent ARIA (CRM Group 2021) which included 102 grid-based shovel tests, all of which yielded negative results. The risk of a loss or disturbance of cultural and heritage resources from WRSA expansion is therefore low. With the implementation of mitigation and contingency measures as outlined above, including the requirement to conduct further testing should ground disturbance be necessary within the 50 m buffer around Square Lake or Moose River, the residual effect on cultural and heritage resources from the WRSA expansion is predicted to be negligible.

Site preparation and ongoing use of the Clay Borrow Area as well as installation of water management structures (e.g., trenching) will require ground disturbance. A portion of proposed area for the Clay Borrow Area expansion is located outside previous ARIA study areas (CRM Group 2005, 2006, 2008). As part of this EA process, an updated ARIA (CRM Group 2021) was conducted to focus on the Clay Borrow Area and determine archaeological potential. CRM Group (2021) recognized that the Clay Borrow Area is comprised of rocky, wet, and sloped terrain and ascribed the area as having low archaeological potential. With the implementation of mitigation and contingency measures as outlined above, the residual effect on cultural and heritage resources from the Clay Borrow Area expansion is predicted to be negligible.

Site preparation, including ditching, for the new Plant Access Road will require ground disturbance. However, the new Plant Access Road is located within study areas assessed in previous ARIAs and determined to have low archaeological potential. With the implementation of mitigation and contingency measures as outlined above, the residual effect on cultural and heritage resources from the relocation of the Plant Access Road is predicted to be negligible.

In summary, given the conclusions of previous ARIAs at the Touquoy Mine Site which have determined that the site has low archaeological potential. While Project activities overlap with higher a higher potential buffer zone, the pre-requisite shovel testing yielded negative results. By implementing mitigation and contingency measures including the commitments for maintaining buffer zones around Moose River and Square Lake and conducting additional archaeological testing if required, residual effects of the Project on cultural and heritage resources is predicted to be not significant.

10.8 FOLLOW-UP AND MONITORING

Based on the ARIAs that have been conducted at the Touquoy Mine Site (CRM Group 2005, 2006, 2008, 2021), it has been determined that Project activities will occur in areas of elevated archaeological potential, which have been subjected to shovel testing and archaeological screening. Follow-up and monitoring is therefore not proposed. In the unlikely event that an archaeological resource is encountered during Project activities, the archaeological contingency plan (Section 1.6) will be implemented as per the Touquoy Gold Project EPP.

Should development activities occur beyond previously assessed areas, or within 50 metres of Square Lake or Moose River, additional archaeological assessment will be undertaken including shovel testing.

Should human remains or archaeological finds of historic, cultural, or paleontological significance be discovered, contact will immediately be made with the necessary authorities (e.g., RCMP, Communities Special Places Program, KMKNO), or others as deemed necessary.

11.0 OTHER UNDERTAKINGS IN THE AREA

The Touquoy Mine Site is located in the rural community of Moose River Gold Mines, a community which has been historically characterized by gold mining with an initial discovery of gold at Moose River in 1866, and sporadic mining activities since 1867. In addition to mining, another undertaking that has occurred sporadically over the years and shaped the current landscape is forestry.

The Nova Scotia Harvest Map Plan Viewer (NSLF 2019) identifies forest patches that are proposed or approved for timber harvesting on Crown land. While the Touquoy Mine Site is partially located on Crown land and there are several Crown land parcels surrounding the Mine Site, the Harvest Map does not show any proposed or approved harvesting on these crown lands. A limitation of this tool however, is that it only applies to Crown lands; there is no equivalent tracker for timber harvesting on private lands.

In addition to general mining and forestry activities in the area, specific undertakings within 30 km of the Touquoy Mine Site are presented in Table 11.1.

Table 11.1 Other Undertakings in the Area (within 30 km radius)

Project/Undertaking	Proponent	Location	Distance to Mine Site
Murchyville Gypsum Quarry (not currently operational – care and maintenance phase)	Knauf	Murchyville	18 km
Pellet Mill	Great Northern Timber	Upper Musquodoboit	15.5 km
Saw Mill/Pallet, Finishing and Chipping Plant/Power Plant	Taylor Lumber Co. Ltd.	Middle Musquodoboit	17.5 km

Other land uses in the area have included residential and recreational land use. Recreational land use includes hunting, trapping, fishing, canoeing, camping and cottage use (particularly on Scraggy Lake and Lake Charlotte). Camp Kidston, which operates only in the summer months, is located on Long Lake, approximately 3.5 km northeast of the Mine Site.

As part of their protected areas program, the Province of Nova Scotia has designated provincially-significant protected areas under the *Wilderness Areas Protection Act*. Ship Harbour Long Lake Wilderness Area extends over 30 km between Musquodoboit Harbour and Mooseland, protecting more than 16,500 ha of rugged woodlands, lakes, and waterways of the Eastern Shore interior. The Ship Harbour Long Lake Wilderness Area is the largest protected area in the Halifax Regional Municipality and is located immediately south of the Touquoy Mine, encompassing a substantial part of Fish River and Scraggy Lake. This wilderness area offers opportunities for wilderness recreation and nature tourism, including angling, hunting, canoeing, and hiking (Province of Nova Scotia 2020).

The Tangier Grand Lake Wilderness Area is located in HRM between Ship Harbour and Mooseland, approximately 10 km southwest of the Touquoy Mine Site. This wilderness area and protects an additional 16,000 ha of wilderness in the region. Tangier Grand Lake, a prominent feature in this wilderness area, is one of the largest lakes in Nova Scotia without direct road access and is well known for its trout fishing, canoe-tripping, and camping opportunities (Province of Nova Scotia 2017).

The Project is not predicted to affect access to or operation of other undertakings in the area including forestry, mining, or residential and recreational land use. The modifications will not result in any substantial additional traffic and there are no new atmospheric emissions (e.g., air, dust, noise, lights) that would affect residential or recreational land use in the area. Access to public roadways and logging trails will not be disturbed or restricted by activities associated with the proposed modifications to the Approved Project. Effects on downstream water resources associated with the Ship Harbour Long Lake Wilderness Area (e.g., Fish River, Scraggy Lake) are assessed in Section 7.0 (Surface Water Resources) and Section 8.0 (Fish and Fish Habitat) and are not predicted to affect recreational use of these watercourses.

There may be changes to the previously assessed viewshed because of the proposed modifications. A Viewshed Analysis (GHD 2021) was conducted to evaluate potential visual impacts associated with the modification of the WRSA on various vantage points, including but not limited to Scraggy Lake, Tangier Grand Lake, Camp Kidston, and Tangier Grand Lake Wilderness Area. The Viewshed Analysis found that given the location of the mine to most observer locations in consideration of relative terrain and tree height, the WRSA will likely be not visible or indiscernible on the horizon (GHD 2021). Areas of Scraggy Lake and Mooseland Road may have a viewshed that includes the WRSA depending on the observation location, although limited visibility of the WRSA is not expected to affect the use or enjoyment of recreational areas.

AMNS holds three other gold development projects in the eastern shore region of Nova Scotia which are proposed as satellite surface mines and involve transporting ore to the Touquoy Mine Site for processing and associated tailings disposal in the exhausted Open Pit. The Beaver Dam Mine Project in Marinette, NS (approximately 18.8 km away from Touquoy Mine Site), and the Fifteen Mile Stream Gold Project (approximately 37.6 km away) are currently undergoing federal and provincial EA review and are assessing the use of Touquoy Mine Site facilities as part of their respective environmental assessment documents (GHD 2017 and AMNS 2021b). The outcome of the regulatory processes for those undertakings has not been determined. Therefore, the use of the Touquoy Mine Site for processing and in-pit tailings disposal for those projects is not assessed in this EARD Should those undertakings be approved and AMNS decides to proceed with their development, required permit amendments for the Touquoy Gold Project site will be sought at that time.

12.0 ACCIDENTS AND MALFUNCTIONS

Accidents and malfunctions are non-routine events that occur outside the normal planned Project activities. The risks of accidents and malfunctions can be reduced or controlled through proper planning and design, and adherence to best management practices. Section 3.0 of this EARD provides an overview of the Proponents EMPs, including emergency response plans that are in place for existing operation of the Approved Project to reduce risks associated with potential accidents and malfunctions.

In addition to the overarching Emergency Response Plan, there are separate emergency response plans to satisfy specific regulatory requirements such as the TMF Emergency Preparedness and Response Plan, Propane Response Plan and Spill Contingency Plan. Existing EMPs (e.g., Erosion and Sediment Control Plan), monitoring plans (e.g., Environmental Effects Monitoring Plan) and contingency plans (e.g., Groundwater Contingency Plan; SD 3) also include controls to reduce likelihood of occurrence and environmental consequences of accidents and malfunctions.

Several accidents or malfunctions could occur as part of the Touquoy Gold Project including a fire or explosion, Open Pit flooding or wall failure, TMF or overflow, and a fuel or hazardous spill. As indicated above, response and contingency plans have been developed for the Approved Project to address these potential accidental events and malfunctions. In consideration of the proposed modifications to the Approved Project involving the WRSA, change in tailings disposal, various ground disturbances, and addition of construction vehicles and machinery to current operation at the Mine Site, the following specific accidental event scenarios were selected for assessment in this EARD

- WRSA slope failure
- failure of water management infrastructure
- tailings line failure
- fuel and hazardous materials spill

12.1 WRSA SLOPE FAILURE

The WRSA is an existing feature of the Approved Project. Weak foundation materials, improper design or construction, and/or erosion from surface water runoff could cause a slope failure of the WRSA, potentially disturbing surface water resources and fish habitat associated with Watercourse #4, adjacent wetlands, rare plants, and potential archaeological and heritage resources.

The proposed expansion of the WRSA will increase the physical footprint of the feature. Design, construction, and monitoring of the WRSA will follow applicable regulations and recommendations provided by a qualified geotechnical professional. The WRSA will continue to be inspected regularly. If signs of deformation are observed, construction activities will cease, and conditions will be reassessed. Additional information on slope stability and the surveillance program associated with the WRSA is included in Golder (2020).

Given proper stockpile design and surface water management, as well as progressive and final reclamation practices, a major stockpile slope failure is unlikely to occur during any phase of the Project. If a slope failure were to occur, equipment and personnel would be evacuated from the area and an assessment would be conducted to determine the need for repairs and reclamation and recommend actions to prevent future incidents.

Overall, in consideration of compliance with engineering design standards, ongoing inspection, emergency response procedures, and if, required, environmental remediation, significant adverse effects on surface water, fish and fish habitat, wetlands, rare plants and heritage and archaeological resources are not likely to occur because of a WRSA slope failure.

12.2 FAILURE OF WATER MANAGEMENT INFRASTRUCTURE

Water management infrastructure is important at the Mine Site to help to promote drainage, reduce risk of erosion and sedimentation, manage surface water flow volumes, and direct contact water to treatment facilities. Current onsite infrastructure includes various ditching, culverts, berms, water management ponds, piping, and pumping equipment. Malfunction or failure of these structures could affect surface water quality and quantity, fish and fish habitat, wetland habitats, and rare plants.

The Project involves the addition of additional water management structures (e.g., ditching, ponds) to help control surface water runoff and maintain flows to Watercourse #4. Surface water runoff from the WRSA, Clay Borrow Area and new Plant Access Road will flow through berms and channels to water management ponds downgradient of these structures. Failure of water management infrastructure could include a breach of retaining embankment through overflow or an embankment structure failure, resulting in an unintended discharge of sediment-laden water into the surrounding environment including watercourses, wetlands, and downstream terrestrial habitats containing rare plants.

Water management ponds and associated infrastructure are designed to attenuate the design storm event, thus preventing flooding. The design storm events consider climate change. Overflow weirs are constructed in water management pond embankments to facilitate safe discharge of flows exceeding the design flows of the ponds.

Since operation commenced for the Approved Project in 2017, there have been reportable instances of siltation, primarily affecting Watercourse #4 and onsite wetlands. In response to these silt events, AMNS implemented various sediment and erosion control mitigation measures, including culvert improvements, ditching improvements, stabilization of exposed soil using hydroseeding or rockfill, construction of lined sediment collection ponds, construction of diversion berms, grading activities, and installation of flocculant logs, haybales, and coir logs (AMNS 2020b; SD1). Performance of these measures have been monitored and continually improved over time based on monitoring results and ongoing advice of sediment control experts, as well as any comments or direction received from NSECC. Current measures involve substantial diversion of surface runoff from site roadways that cross Watercourse #4. An assessment of effects of siltation concluded effects appeared to be minor and reversible if further siltation events are prevented. Follow-up monitoring was recommended for 2020, 2022 and 2024 to confirm that implemented mitigation was effective and that affected areas are naturally restoring to baseline conditions.

The Erosion and Sediment Control Plan (ESCP) for the Touquoy Gold Project (Stantec 2020b; SD2) describes the environmental controls that have been installed and maintained for specific activities and ongoing operation to avoid or reduce site erosion and protect nearby watercourses and wetlands from sedimentation. The ESCP will be updated to account for changes at the site associated with the proposed modifications.

If there was a failure or malfunction of water management infrastructure, emergency procedures would be implemented as per the ERP. Equipment and personnel would be mobilized to the area to reduce releases and an assessment would be made (drawing in external specialists as needed) to determine appropriate repairs, remediation, and future mitigation to prevent future incidents.

Overall, in consideration of compliance with engineering design standards, ongoing inspection, and monitoring of controls for condition and effectiveness, emergency response procedures, and if, required, environmental remediation, significant adverse effects on surface water, fish and fish habitat, wetlands, and rare plants are not likely to occur from a failure of water management infrastructure.

12.3 TAILINGS LINE FAILURE

Construction, operation, and closure of TMF (routine activities and accidental events) was assessed as part of the Approved Project (CRA 2007a). A proposed modification to the Approved Project involves directing tailings from the Mill Facility to the exhausted Open Pit instead of the TMF. This will require installation of a new tailings line. Process controls will be in place to detect a pipeline leak or spill and initiate shutdown procedures.

A failure of the new tailings line could result in an unintended release of tailings slurry and water to the surrounding environment, potentially affecting surface water, fish and fish habitat, and terrestrial environment (e.g., wetlands, rare plants, birds) depending on the location and severity of the breach.

AMNS recognizes tailings management as an important issue for the Touquoy Gold Project and has implemented a tailings stewardship management strategy which promotes best applicable practices (BAPs) for the proper design, construction, operation, maintenance, monitoring and ultimately closure of the TMF. These BAPs are consistent with guidance from the Mining Association of Canada (2017, 2019) and Canadian Dam Association (2013) and key aspects include corporate governance, Engineer of Record, third-party independent reviews, and collaboration with stakeholders.

Corporate governance commitments made by AMNS have involved the development and implementation of various management plans to manage TMF operation including the TMF Operation, Maintenance, and Surveillance (OMS) Manual, TMF Emergency Preparedness and Response Plan (EPRP), and the TMF Operational Preparedness and Response Plan (OPRP). The OMS Manual outlines procedures for measuring performance of the TMF and demonstrating due diligence during operation. The TMF EPRP plan provides an emergency response protocol in the event of an emergency at the TMF, outlining responsibilities of key personnel, providing guidance on identifying an existing or potential emergency and the severity of the emergency as it relates to potential failure of the TMF or impact on the environment. The TMF EPRP outlines preventative and remedial actions for a potential or existing emergency. The OPRP was developed to provide procedures to be followed if water levels within the tailings pond encroach within the zone designed for Inflow Design Flood storage and there is risk of potential overtopping of the dam. These Plans will be updated as applicable to acknowledge the proposed modifications to the Approved Project redirection of tailings from the Mill Facility to the exhausted Open Pit for disposal through the installation of a new tailings line.

In January 2019, AMNS reported a release of approximately 300,000L to 400,000 L of tailings from the existing tailings line. The slurry was observed in the ditch near a pressure check valve on the tailings line and was contained within the site ditches and emergency spill pond. Much of the tailings slurry had frozen solid in place and the environmental response team confirmed the flow path did not extend toward Watercourse #4. This release was assessed and remediated by an independent site professional, with all clean-up activities documented and reported to NSECC following the requirements of the Nova Scotia Contaminated Sites Regulations. An investigation found the cause of the release to be a failed gasket on the tailings line adjacent to the tailings pump building. As required by AMNS BAPs, the ITRB conducted a review of the incident and did not identify any areas of non-compliance or conditions which compromise TMF integrity. The ITRB concluded from its 2019 review that the overall stewardship of the TMF met its expectations of good practice. Corrective actions included fusing the pipe to address the weak point in the line, installing a berm along the corridor of the tailings and decant lines to improve containment in case of future release events, and adding the removal of ice buildup around the culvert in the storm water pond to the regular maintenance routine to prevent future blockages. Lessons learned from this event will be applied to the design, operation, and maintenance of the new tailings line.

Although unlikely to occur given the implementation of BAPs, a tailings line breach could occur, as evidenced by past events. In this event, applicable emergency response procedures would be implemented to avoid or reduce adverse effects on the surrounding environment with clean-up and remediation undertaken, as required. Surface water samples would be taken with results compared to CCME FWAL TSS guidelines and MDMER TSS guidelines to determine the extent of downstream impacts on surface water quality and fish habitat. If the tailings encroach on neighboring properties or public roadways, the appropriate authorities will be notified and bunds and/or diversion drains may be constructed to contain tailings onsite. Following immediate response and mitigation, an assessment will be made using on-site staff and possibly external resources (surface water specialists) as to what repairs are needed and actions to prevent future incidents, with these findings detailed in a Recovery Plan.

Overall, in consideration of compliance with engineering design standards, ongoing inspection and monitoring, implementation of BAPs, emergency response procedures, and if, required, environmental remediation, significant adverse effects on surface water, fish and fish habitat, and terrestrial environment are not likely to occur from a tailings line failure.

12.4 FUEL AND HAZARDOUS MATERIAL SPILL

The proposed modifications will not involve the transport, use or storage of any new hazardous materials at the Mine Site. However, construction activities associated with the proposed modifications (e.g., proposed Plant Access Road construction, installation of water management structures and new tailings pipeline) will result in a temporary increase in the operation and maintenance of mobile equipment which could increase risk of an accidental fuel leak or spill. There is no change to the Approved Project with respect to chemical or fuel storage, but spills could occur through improper fuel transfer procedures, fuel-hydraulic line breaks or spills, and/or mobile equipment and refueling truck accidents. Diesel fuel will be used in large mobile equipment; other petroleum-based and non-petroleum-based liquids will be used for equipment maintenance.

The EPP describes environmental protection measures to prevent and respond to spills including measures related to fuel storage and handling, hazardous materials and hazardous waste management, and spill response and reporting. The Spill Contingency Plan, which supplements the ERP, describes actions for the prevention, response to, and recovery of the uncontrolled release of hazardous material to the environment.

Effects of a spill would vary depending on the type and volume of material spilled, the location of the spill (e.g., proximity to watercourse, wetland, or other environmentally sensitive area), and timing (i.e., seasonality) of the spill. A fuel or hazardous material spill could contaminate soil, surface water and/or groundwater and affect fish and fish habitat, wetlands, or other terrestrial environment (e.g., rare plants, birds).

A worst-case scenario would be a transportation collision near an environmentally sensitive area (e.g., Watercourse #4) causing the entire amount of fuel from the vehicle to be spilled into the sensitive area, potentially contaminating that receptor as well as downstream habitats and groundwater resources in the area. A spill could result in an unauthorized HADD, and injury or mortality to aquatic (e.g., fish) and/or terrestrial wildlife (e.g., birds). A worst-case scenario spill could therefore potentially result in significant adverse environmental effects to groundwater, surface water, fish and fish habitat, and terrestrial environment. Such a worst-case spill would be unlikely to occur.

A spill associated with the proposed modifications at the Mine Site would be unlikely to reach sensitive receptors (e.g., watercourses, wetlands) due to limited ecological receptors at the Mine Site, existing water management systems in place which would facilitate containment and cleanup efforts, and execution of emergency response procedures.

If a spill were to occur, emergency procedures would be implemented as outlined in the Spill Contingency Plan. Generally, spill response includes raising the alarm, evacuation of all equipment and personnel from the area and establishment of radius exclusion zone from the spill location. An assessment is then made using on-site staff and external resources as needed, to determine the type, quantity, and source of the spill. If it is safe to do so, the spill source will be shut down and any ignition sources will be isolated. A plan to contain and clean up the spill, as well as actions to prevent future incidents, will be detailed in a Recovery Plan.

Overall, in consideration of the implementation of environmental protection measures to prevent spills, emergency response procedures, and if, required, environmental remediation, significant adverse effects on surface water, fish and fish habitat, and terrestrial environment are not likely to occur because of a fuel or hazardous material spill.

13.0 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

Local environmental conditions could affect or damage Project infrastructure resulting in failures, malfunctions, or accidental events, which in turn, could result in adverse effects to the environment. The Government of Canada lists floods, hurricanes, landslides, severe storms, storm surges, tsunamis and wildfires amongst Nova Scotia's natural risks and hazards in the federal Get Prepared campaign (Government of Canada 2018). The provincial Guide to Preparing an EA Registration Document for Mining Developments in Nova Scotia (NSECC 2009) specifically identifies climate and meteorological conditions as environmental factors which may have effects on mining developments to be considered in an EA Registration. The EA for the Touquoy Gold Project (CRA 2007a) considered the effects of meteorological conditions on mining activities. In their Guide to Considering Climate Change in Environmental Assessments in Nova Scotia, Nova Scotia Environment (2011) (now referred to as NSECC) also reminds proponents conducting EAs to consider the impacts of climate change on a project.

In consideration of the above, the assessment of the effects of the environment on the Project considers the following environmental conditions/events which could potentially affect Project components and/or activities during the construction, operation, or decommissioning, rehabilitation, and closure phases.

- climate and climate change (including extreme weather)
- geological hazards (e.g., erosion)
- wildfires

Each of these categories of physical hazards is discussed below in the context of potential environmental effects. The design of the Project, including the development of mitigation measures, will reduce the potential for substantial adverse effects of the environment on the Project. Applicable mitigation measures to reduce potential occurrence and severity of adverse effects are presented and a summary of residual effects (post-mitigation) is provided.

This assessment is closely linked to the Accidents and Malfunctions (Section 12.0).

13.1 POTENTIAL ENVIRONMENTAL EFFECTS

13.1.1 Climate and Climate Change

The nearest climate station to the Touquoy Mine Site is the Middle Musquodoboit climate station (ID# 8203535). This station is located approximately 15 km northwest of the Mine Site, near Middle Musquodoboit (45°04'N, 63°06'W) and is the most representative, although it is no longer active and is used for historical context. Based on data collected between 1981 and 2010, the historical mean annual total precipitation for the Middle Musquodoboit climate station is 1,360 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 is generally highest in September through November. The extreme one-day precipitation events recorded at the Middle Musquodoboit station are 173 mm of rainfall on August 15, 1971 and

70 cm of snowfall on February 8, 1981. The average temperature is 6.4°C with an average range from -6.2°Cto 18.5°C. The warmest months of the year are July and August, both of which have daily average temperatures above 18°C. Extreme temperatures range from -34°C to 35.6°C. The climate station at the Halifax Stanfield International Airport (Climate ID: 8202250) is the nearest active station and is used to inform ongoing operation at the Touquoy Mine Site. The Halifax Stanfield International Airport station records a higher volume of total precipitation than the Middle Musquodoboit station and is used in water balance modelling for the site (Section 7.4.2).

Based on general climate change predictions, it is expected that future climate change could result in increased air temperatures, increased frequency and intensity of precipitation, an increase in the frequency and magnitude of storm events, and increased incidence of flooding and erosion. Predicted sea level rise is not expected to affect the Project given the interior location of the Touquoy Mine Site within the province. Potential effects of climate change associated with extreme temperatures, heavy precipitation, winds, and storms could include delay and/or interruption of Project activities; loss of electrical power; and damage to site access, infrastructure, and equipment.

Extreme precipitation and associated surface water runoff could potentially cause flooding, erosion, washout of site roads, overload of the site water management infrastructure, and failure of erosion and sedimentation controls. These effects could, in turn, lead to further erosion, sedimentation of surface waterbodies, and unplanned release of contact water potentially affecting the quality of surface water resources, fish and fish habitat, terrestrial environment (e.g., wetlands, rare plants) and wildlife which depend on these resources. Alternatively, reduced precipitation (e.g., drought) could affect water balances and require additional water input (including lake water withdrawal) for operational use (e.g., Open Pit infilling for tailings disposal) and dust suppression.

Extreme temperatures and storms (e.g., ice, snow, lightning, high winds) could damage site infrastructure and/or cause injury to site workers. The Project will be designed to accommodate extreme precipitation (rain and snow) events and high wind ranges, AMNS' Occupational Health and Safety Plan for the Touquoy Gold Project will be implemented to protect worker safety in the event of extreme weather.

13.1.2 Geological Hazards

Geological hazards, including landslides, rockfalls, erosion, subsidence, and seismic activity, could potentially affect the Project and result in adverse environmental effects.

The entire province of Nova Scotia is categorized as having a low seismic hazard by the Geological Survey of Canada (2015). Since 1987, there have been 57 earthquakes in the province as recorded in the National Earthquake Database. Most of these earthquakes have been at a magnitude of 2 or lower, with no earthquakes higher than a magnitude of 3. The closest recorded earthquake to the Touquoy Mine Site is an earthquake with a magnitude of 1.7 in Enfield in 2003 approximately 44 km from the Mine Site. Although unlikely to occur, seismic activity could affect the Project through primary impacts such as slope and pit wall failures and damage to infrastructure associated with ground vibrations. Site infrastructure is 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 vicinity of the Project. Modifications proposed as part of this Project will also adhere to the National Building Code of Canada.

There is no evidence of landslides or rockfalls in the RAA, and the probability of such an event occurring is considered low based on a review of the terrain and geological conditions. However, several Project components could potentially experience slope failures including the Open Pit or the WRSA. Slopes associated with these features will be designed at a slope determined by geotechnical analysis and acceptable safety factors to reduce the risk of slope erosion and subsidence in recognition of factors such as stratigraphy of the site (e.g., surficial soils, bedrock), depth to groundwater, porewater pressure generation, seismic conditions, and external loads.

Sites associated with the Open Pit, WRSA, Clay Borrow Area, and Plant Access Road are also vulnerable to erosion through traffic movement, runoff from precipitation and clearing, grubbing and grading activities.

Geological hazards will be managed through engineering design (Section 13.2).

13.1.3 Wildfires

Wildfires could damage Project infrastructure, affect site accessibility, endanger the health and safety of site personnel, and reduce visibility, causing interruptions and/or delays in Project activities.

Nova Scotia has a relatively wet climate and thus generally experiences fewer fires in a given season compared to drier provinces (NSLF 2013). The Canadian National Fire Database (CNFD) (NRCan No Date) is a collection of forest fire data from various sources between 1980 and 2019 and indicates the perimeters of past forest fire locations. The CNFD shows the province of Nova Scotia to have had relatively few forest fires since 1980, with most of those reported in the southwest region of the province. The closest fire to the Touquoy Mine Site, as reported by the CNFD, was approximately 20 km east near Lindsay Lake and occurred in 1991.

The management, monitoring and control of forest fires in Nova Scotia are the responsibility of NS Lands and Forestry (NSLF). Forest fires detected by the public are reported to NSLF by calling 1-800-565-2224 or 911. During periods of high to extreme fire hazard, NSLF uses fixed winged aircraft for aerial detection. Forest fires are distinguished from fires that could result from Project activities and spread to surrounding areas. The AMNS response to and the potential effects of Project-related fire scenarios are addressed in Section 10.0.

13.2 MITIGATION

The Touquoy Gold Project has been designed and constructed to meet applicable engineering codes (e.g., National Building Code of Canada [NBCC; NRC 2015], and applicable guidelines (e.g., Canadian Dam Association and Mining Association of Canada), standards and best management practices. These guidance documents will also apply to the design and construction of the proposed modifications. In addition, the following mitigation measures will be implemented to reduce adverse effects of the environment on the Project:

- The Erosion and Sediment Control Plan for the Touquoy Gold Project (Stantec 2020b; SD2) will be updated as necessary to account for the proposed modifications.
- AMNS is committed to work with an independent professional engineer who will be retained to inspect, design, report and /or advise on the status of soil erosion and sedimentation controls during construction and will take required action to maintain, repair and upgrade infrastructure/equipment as needed in a timely manner.
- Project activities will be scheduled in consideration of seasonal conditions and weather forecasts as applicable. This may include a delay of activities due to poor weather.
- Weather forecasts will be regularly monitored and prior to extreme weather events, appropriate preventative measures will be taken to reduce the risk of damage to the Project. This will include inspections as noted above, including but not limited to inspection / maintenance of sediment and erosion control measures prior to and following precipitation events.
- Geotechnical investigations will be completed prior to construction to assess site-specific conditions and risk of geological hazards (e.g., slope failure). Results of these investigations will be used to complete designs and meet requirements of applicable building codes.
- Water management structures will be designed to attenuate the design storm event, thus preventing flooding. The design storm events consider climate change. Overflow weirs are constructed in water management pond embankments to facilitate safe discharge of flows exceeding the design flows of the ponds.
- The WRSA design will consider collected geological data and will be designed with slopes at the angle determined by geotechnical analysis and acceptable safety factors.
- The Emergency Response Plan for the Touquoy Gold Project describes emergency response measures, training requirements, roles and responsibilities, and reporting procedures in the event of a fire at or near the Mine Site.
- On-site fire prevention and response equipment will be provided and maintained, and AMNS will have employees / teams that will be trained in safe fire response for a fire at the Mine Site.

13.3 SUMMARY OF RESIDUAL EFFECTS

Potential adverse effects on the Project by the physical environment including climate and climate change, geological hazards, and forest fires have been, and will continue to be, an important consideration throughout the planning and engineering stages of the Project.

These potential effects will continue to be considered during the construction, operation and decommissioning, rehabilitation, and closure stages. Effects of the environment are largely addressed through Project planning and engineering design. The Project will rely on design standards and proven methods and technologies that have been tested and proven successful in similar environments across Canada. AMNS will also follow industry standards and best practices in designing for and preventing adverse effects of the environment on the Project.

In general, a significant effect on the Project from the environment would include:

- environmental conditions that cause harm to Project personnel and/or the public
- environmental conditions cause extended delays in construction or a shutdown of the operation
- environmental conditions that damage Project infrastructure to the point repair is not feasible

In consideration of project design to accommodate extreme environmental conditions and other mitigation measures, no significant adverse environmental effects are anticipated due to effects of the environment on the Project. Adverse environmental effects from accidental events and malfunctions are assessed in Section 10.0.

14.0 SUMMARY AND CONCLUSIONS

The Touquoy Gold Project is an open pit gold mine operated by AMNS under Industrial Approval #2012-0824244-08. Several modifications are required to support ongoing operations of the Touquoy Gold Project including:

- use of the exhausted Open Pit for tailings disposal instead of the existing approved TMF
- expansion of the WRSA
- expansion of the Clay Borrow Area
- relocation of the Plant Access Road used to access the Plant Site

These modifications represent the Project subject to environmental assessment under the provincial Environment Act and, upon release from the EA process, will require an amendment to the current Industrial Approval for the Touquoy Gold Project.

Potential adverse effects of the Project on groundwater resources, surface water resources, fish and fish habitat, terrestrial environment, and cultural and heritage resources will be avoided or reduced through regulatory compliance, adherence to existing management plans for the Touquoy Gold Project, implementation of best management practices, and implementation of site-specific design features. Existing contingency and emergency response plans for the Touquoy Gold Project will be implemented to reduce risk and consequences of accidental events and malfunctions.

Residual effects of routine Project activities are predicted to be not significant. The magnitude of effects of accidental events or malfunctions could vary, however in consideration of compliance with engineering design standards, ongoing inspection, emergency response procedures, and if, required, environmental remediation, significant adverse effects are not likely to occur.

Ongoing monitoring programs for groundwater, surface water, fish and fish habitat, and wetlands will continue and will be modified as necessary to capture changes to the site layout and activities as a result of the Project. These monitoring programs will confirm regulatory compliance and effectiveness of mitigation measures, as well as help identify the need for additional mitigation and adaptive management at the Touquoy Mine Site.

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Personal Communication

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